# The American Journal of Obstetrics and Gynecology

VOL. II. ST. LOUIS, JULY, 1921 No. 1

## Original Communications

### THE INDUCTION, COMPLICATED BY HEMORRHAGE, OF LABOR*

BY EDWARD P. DAVIS, M.D., F.A.C.S., PHILADELPHIA, PA.

THE induction of labor has established its place among the most valuable operations of obstetric surgery. The indications for its performance have, of late, been considerably changed by the increased performance of cesarean section and by the more frequent use of analgesia and anesthesia in labor. The distinction between the induction of labor and the emptying of the uterus by dilatation and curetting, or by elective operation, must not be forgotten.

At present, in primiparous patients labor is rarely induced for contracted pelvis, but is indicated in cases where pregnancy is turning the scale against the general health of the patient and where the saving of health or life may be hoped for if pregnancy is terminated. Such are cases of disease of the heart complicated by pregnancy, tubercular infection complicated by pregnancy, toxic conditions not yielding to treatment, and where a profound disorder of the nervous system is greatly aggravated by pregnancy.

In multiparous patients, induction of labor is more frequently indicated. In cases where patients have had several difficult labors with children disproportionate to the mother's pelvis; in cases where, after having several children, the mother shows a tendency to go overtime, and in cases of severe visceral disease in multiparous patients, labor is often induced.

In placenta previa, labor may be induced to advantage when the

*Read at a meeting of the Philadelphia Obstetrical Society, January 6, 1921.

NOTE: The editor accepts no responsibility for the views and statements of authors as published in their "Original Communications."

situation of the placenta is such that rupturing the membranes alone will suffice to control hemorrhage through pressure by the presenting part. In other cases of placenta previa and in accidental separation of the normally implanted placenta, delivery by section is indicated.

In fulminant toxemia, with or without convulsions, induction of labor is only indicated when the patient is practically in and has largely completed the first stage of labor. Then the rupture of the membranes will be followed by the temporary cessation of the convulsions, which will return with increased violence when the uterus begins to act.

Two methods at present are commonly employed; one, the introduction of a foreign body within the uterus to stimulate uterine contraction, or the stimulation of the uterine contractions by rupturing the membranes and lessening the quantity of amniotic liquid, or, second, the administration of drugs. The induction of labor by psychic effect, while occasionally successful, is unreliable.

In inducing labor, it is well not to ignore the mechanism of labor. The unshortened and unsoftened cervix requires something more than simple stretching in a lateral direction at right angles to the long axis of the uterus. The dilating bag does not favor the softening or retraction of the cervix, and this is one of the disadvantages attending this method. The introduction of bougies or a rectal tube, or gauze promotes the softening of the cervix, its retraction and obliteration, and is not likely to displace the presenting part. This method is not especially painful, or likely to result in septic infection.

If the statement of patients can be believed, the use of dilating bags causes severe pain and sometimes tends to displace the presenting part. Accidents in the use of the bag, resulting in the bursting of the bag and the escape of liquid or air into the uterus need not result seriously.

It has been urged as an objection to the use of bougies that they may separate the placenta or pierce or wound the tissue at the placental site in such a manner as to cause hemorrhage. This paper is largely concerned with the discussion of this topic.

Before narrating our cases, it may not be amiss to call attention to the induction of labor by the use of drugs. Castor oil, quinine and pituitrin are those commonly selected. This method has received full exposition by Watson of Toronto, who publishes a considerable series of cases and is satisfied with his results. Choosing a favorable time, he gives castor oil, quinine dissolved in dilute hydrochloric acid, and follows this by small doses of pituitrin, given sufficiently often to initiate and continue uterine contraction. When labor has once been established, it is allowed to proceed, if possible, spontaneously.

In the administration of drugs, the psychic element can rarely be

completely eliminated. If a patient is positively told that certain effects will follow the taking of a given drug, such effects are enhanced. Of this, the writer had an interesting illustration when a patient, a trained nurse, who married a physician, and who presented a moderately contracted pelvis, desiring to avoid operation, consented to the induction of labor. The patient was familiar with the circumstances and the reasons for the proposed interference. All preparations were made for a given day. The only medication employed was a simple laxative. Without interference or the further use of drugs, the patient came into labor at the time appointed. Furthermore, the patient repeated this performance twice afterward, on each occasion the preparations for inducing labor were fully carried out, the result being a psychic effect which produced the desired result.

We recognize hemorrhage during pregnancy as that which is not concealed and in which blood escapes through the vagina, or that which is concealed, where blood accumulates in the uterus, in the abdominal cavity or between the layers of the broad ligaments. In the writer's experience with the induction of labor, hemorrhage has occurred and the cases seem of sufficient interest and importance to justify their narration.

CASE 1. A woman whose first pregnancy had been terminated by the use of forceps. In her second pregnancy, domestic complications had caused great nervous disturbance; the patient's general physical condition was impaired and she had gone overtime, with no sign of labor. She entered the Jefferson Hospital and under anesthesia by nitrous-oxide and oxygen, the cervix was dilated somewhat by the gloved hand, the membranes separated from the lower portion of the uterus and two bougies were inserted without difficulty. The fetal head was presenting, but was freely movable at the pelvic brim. The introduction of the bougies was followed by considerable oozing hemorrhage, the blood was dark in color, the quantity not excessive. The bougies were introduced in the afternoon. A vaginal packing of ten per cent iodoform gauze was used. During the night and the following morning, hemorrhage persisted, although of moderate quantity. Labor did not develop. There was no evidence of placenta previa, neither was the patient highly toxic. The patient had been, before marriage, a trained nurse, and understood thoroughly the points in her case.

In view of the hemorrhage, the failure of labor to develop and the fact that the patient's circumstances in life were such that each pregnancy must be an extraordinary burden, the patient and her husband requested delivery by operation, with sterilization. This was readily accomplished by abdominal section, followed by the delivery of the child and supravaginal hysterectomy. The ovaries were left, the appendix was removed. Mother and child recovered from the operation without incident.

On examining the uterus, it was lined with an extraordinarily thick and soft membrane. At the time of operation, it was observed that the placenta had not separated, nor had the bougies touched the placenta, or done violence. They were in proper position between the membranes and the wall of the uterus.

A thorough microscopic examination of the specimen revealed the cause of the

hemorrhage. The patient had chorioepithelioma, the microscopic appearance of the uterus being highly characteristic of that condition.

The patient was last seen five years after the operation in good general condition.

CASE 2.—A remarkably robust multipara, who had given birth to large children with considerable difficulty and suffering. The essential element seemed to have been the excessive size of the child. Accordingly, in the fourth pregnancy, it was determined to induce labor at term. The position and presentation were normal, the pelvis was slightly larger than the average, the membranes unruptured, the patient's general condition good. Under nitrous-oxide and oxygen anesthesia, the cervix was dilated by the gloved fingers, the membranes separated, a thorough examination made, which revealed no abnormality. Two bougies, one after the other, were then inserted very gently and carefully, passing up on the left side of the pelvis between the membranes and the wall of the uterus. The introduction of these bougies was followed by a hemorrhage so profuse that the sound of the blood pouring into a bucket beneath the edge of the bed was distinctly heard. A vaginal packing of iodoform gauze was at once introduced and the abdomen again examined, and evidence was found that the placenta had begun to separate. The husband of the patient was immediately notified of the condition and the patient was delivered by abdominal cesarean section. It was feared that the bougies had separated the placenta, pierced its substance, or done some important injury.

On section the bougies were in the position to which they had been introduced on the left side of the uterus, the placenta was attached on the right upper portion of the uterus and had begun to separate. There was no connection then between the bougies and the separation of the placenta, unless it was that the bougies had set up uterine contraction which began the separation of the afterbirth. The uterine decidua seemed unusually friable and the placental substance contained considerable calcareous matter. A vigorous child was readily delivered, the uterus emptied and sutured by closing the muscle with buried stitches of medium-sized, best quality silk, stitching over the peritoneal covering of the uterus with continuous catgut and closing the abdomen in the usual manner. The patient's recovery was uncomplicated and she nursed her child successfully. The placenta had separated through about one-fourth of its lower portion.

It may be interesting to note that within two years after this operation, this patient gave birth to a living child, well-developed, with very little assistance. Labor developed at term, and when dilatation was complete, the membranes were ruptured and the patient completely anesthetized with ether and oxygen. Vigorous uterine contractions developed, which brought the head to the pelvic floor, whence it was readily extracted by the hands. The placenta was immediately removed by introducing the hand within the uterus and the interior of the uterus was thoroughly palpated. No evidence of the former operation could be detected. Mother and child made an uninterrupted recovery.

In this case had the woman not been in the first instance delivered by section, it might always have been supposed that the bougies wounded the placenta or partially separated it. It was absolutely proved by direct vision that the bougies did not touch the placenta, nor were they even on the same side of the uterus.

CASE 3.—A multipara whose first labor had been difficult, terminated by forceps, with considerable laceration. To avoid further complications, as a complete repair operation had been done, it was decided to induce labor in a subsequent pregnancy. The pelvis was of average size, the presentation and position favorable, the patient's general condition good. Nitrous-oxide and oxygen were administered, the cervix dilated, the membranes separated and two bougies inserted. There was considerable

hemorrhage accompanying their insertion. This readily ceased on the introduction of the vaginal packing with ten per cent iodoform gauze. Labor developed within eight hours and was terminated by the use of forceps. A living child was delivered, without difficulty, and mother and child made good recovery. The cause of the bleeding could not be ascertained; the placenta was intact, no wound or lesion of the cervix or uterus could be found.

CASE 4.—Bougies were introduced to induce labor in the case of a patient in the wards of the Maternity Department of the Jefferson Hospital. No complication attended their introduction; the patient went into labor, was delivered spontaneously. When the placenta was delivered, one of the bougies was sticking through its substance, having perforated the placenta completely. This condition would not have been discovered by any symptom or complication arising during the labor. There was during the labor no hemorrhage whatsoever.

One can readily understand that if the placenta be attached unusually low it might easily be wounded by bougies, and hemorrhage result. Any cause which produced uterine contraction in a toxic patient, or one whose decidua was diseased, might result in separation of the placenta. Chorioepithelioma would certainly bleed if bougies were introduced into such a uterus during pregnancy. In case three, however, where no complication could be found and slight hemorrhage occurred, an explanation for the hemorrhage is not forthcoming.

It may be suggested that the use of a new sterile rectal tube which does not pass beyond the lower uterine segment is safer than the use of bougies. The writer has employed this method with satisfaction in several cases. It is not, in his experience, as prompt in its action, nor does it soften the cervix so thoroughly as the use of bougies.

From his experience, the writer is not inclined to believe that the use of bougies does cause serious hemorrhage. On the whole, in his experience, this method has been the most uniformly successful of any employed for the induction of labor. It has produced the result of more closely resembling spontaneous parturition than any other.

The literature on the subject throws no light upon the question. Cases are recorded where the placenta has been lower than usual and bougies have wounded the placental tissue, but the writer has been able to find no case where serious injury to mother or child has followed the use of bougies in the induction of labor.

250 SOUTH TWENTY-FIRST STREET.

# SOME CHEMICAL STUDIES IN NORMAL AND ABNORMAL PREGNANCIES*

## 1. Significant Chemical Changes in the Blood in the Toxemias of Pregnancy

By John A. Killian, Ph.D., and Carl P. Sherwin, Sc.D., M.D., New York, N. Y.

*From the Laboratory of Pathological Chemistry, New York Post Graduate Medical School and Hospital, and the Department of Chemistry, Fordham University, New York, N. Y.*

WITHIN recent years metabolism in pregnancy and the causation of the toxemias during this period have been the subject of numerous investigations. The results obtained, however, have left much to be desired. Some workers have attempted to establish an acid intoxication as the cause of eclampsia. Zweifel[1] reports a case of pregnancy toxemia in a primipara, in whom after four convulsions he isolated in considerable quantities sarcolactic acid from the urine, maternal and fetal blood, and the placenta. The concentration of this acid in the maternal venous blood was found to be 0.008 per cent, but 0.025 per cent in the blood of the umbilical cord. It would appear, then, that the maternal organism absorbs sarcolactic acid from the fetus and thus an acid intoxication results. However, subsequent workers have shown that the excretion of lactic acid is not characteristic of eclampsia, and in this condition is probably due to the epileptiform convulsions. Hasselbalch and Gammeltoft[2] working with hydrogen-ion concentration of the blood and the carbon dioxide tension of the expired air have found during normal pregnancy a compensated acidosis, but in some cases of eclampsia an uncompensated acidosis resulting in a definite increase in the hydrogen-ion concentration of the blood. Of eleven cases of pregnancy of nearly full term, examined by Menten[3] the blood serum of one showed an increased alkalinity, but in the remaining no deviation from the normal. Recently, White[4] has reported some interesting results upon alkali tolerance as a measure of the acidosis in pregnancy toxemias. With Sellards' method[5] he has determined the tolerance for sodium bicarbonate in normal pregnant cases to be 6.8 gm., slightly above the normal for nonpregnant patients. The average tolerance for cases of pregnancy toxemias that eventually recovered was 45.3 gm., while that for toxemias terminating fatally was 67 gm., and finally pregnancy complicated by nephritis had an average tolerance of 33 gm. Losee and Van Slyke[6]

*A report of this work was made before the New York Pathological Society by one of us (K) on February 9, 1921.

determined the percentage volume of carbon dioxide bound in the form of bicarbonate in the blood plasma in 14 cases of normal pregnant women. All gave figures below 65, and 10 below 55. However, the cases of toxemia of the eclamptic and vomiting type showed only a slight variation from normal in the alkali reserve of the blood plasma, in spite of the fact that in some cases the ammonia excretion was greatly increased.

As a further index of the acidosis, considerable attention has been devoted to the ammonia excretion in the urine. It was noted by Hasselbalch and Gammeltoft[2] that although the titrable acidity of the urine was decreased, the ratio of the ammonia nitrogen was increased during pregnancy, but after parturition this returned to normal. The ammonia excretion was determined by the formol titration method. Losee and Van Slyke,[6] and as well Ewing and Wolf,[7] have reported an increased excretion of ammonia, with a markedly decreased elimination of urea. In the cases of pernicious vomiting this was particularly evident. Wilson[8] has observed a tendency towards an increase in the ammonia nitrogen in the last weeks of pregnancy. Further, while Williams[9] has stated that eclampsia is characterized by a marked decrease in the amount of nitrogen excreted as urea, but a definite rise in the quantity eliminated as ammonia, Murlin and Bailey[10] have found no greater ratio of ammonia N in toxic than in the last month of normal pregnancies. Since Sellards[11] has established the fact that the excretion of ammonia may be normal in acidosis, and on the other hand, the ammonia eliminated may rise to 2 gm. per day without any other evidence of acidosis, obviously the determination of the quantity of this compound excreted, and of the ammonia coefficient is not a reliable index of an existing or suspected acidosis. Again, Underhill and Rand[12] have pointed out that the composition of the urine in pernicious vomiting is strikingly similar to that found in inanition, and following the administration of carbohydrate by mouth or by rectum there is a distinct tendency towards a resumption of the normal elimination of the ammonia.

In contrast to these apparent contradictions, we find a greater uniformity of the results of investigations of the chemical composition of the blood in these conditions. In a preliminary report, Folin[13] states that the urea nitrogen of the blood of pregnant women varies from 5 to 9 mg. per 100 c.c., and the nonprotein nitrogen, except in toxic cases, does not exceed 30 mg. The urea nitrogen, then, forms 20 to 35 per cent of the nonprotein nitrogen. In 35 normal obstetrical cases, Slemons and Morris[14] found the average nonprotein nitrogen to be 25.2 mg., whereas the average urea nitrogen was 10.4 mg., 44 per cent of the nonprotein nitrogen. The lowest urea nitrogen observed was 8.4 mg. Recently Caldwell and Lyle[15] in a series of 150 carefully selected, normal, pregnant women, (from seven to nine months' gesta-

TABLE I

CHEMICAL CHANGES IN THE BLOOD IN NORMAL PREGNANCY AND PREGNANCY TOXEMIAS **

| CASE | AGE | PARA | MOS. OF GEST. | BLOOD ANALYSES | | | | | | | | URINE | | BLOOD PRESSURE | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NON-PROTEIN-N | UREA N | UREA-N | URIC ACID | CREATININE | SUGAR | CHLORIDES | $CO_2$ COMBINING POWER | PROTEIN | CASTS | SYSTOLIC | DIASTOLIC | |
| | | | | M. G. PER 100 C. C. | | N-P-N PER CENT | M. G. PER 100 C. C. | | PER CENT | | | | | | | |
| **Normal Pregnancies** | | | | | | | | | | | | | | | | |
| 1-A. P. | 20 | I | 5 | 25 | 11 | 42 | 2.0 | 2.3 | 0.13 | 0.48 | | + | − | 130 | 90 | |
| 2-N. C. | 25 | I | 7½ | 25 | 11 | 45 | 2.6 | 2.1 | 0.14 | 0.46 | 42 | + | − | 120 | 70 | |
| 3-A. S. | 23 | I | 8 | 24 | 11 | 47 | 2.6 | 2.5 | 0.10 | 0.48 | 49 | − | − | 110 | 65 | |
| 4-E. Q. | 27 | I | 8 | 22 | 10 | 44 | 2.5 | 2.4 | 0.11 | 0.48 | 44 | + | − | 130 | 90 | |
| 5-M. N. | 33 | III | 8 | 21 | 9 | 44 | 1.9 | 2.0 | 0.10 | 0.48 | 39 | − | − | 130 | 85 | |
| **Nephritic Toxemias** | | | | | | | | | | | | | | | | |
| 1-C. Q. | 27 | III | 6½ | 106 | 72 | 67 | 8.1 | 3.7 | 0.12 | 0.42 | 40 | + + + + | − | 210 | 140 | Neuroretinitis. No edema. Delivered by bag. Improvement slight. |
| 2-C. C. | 32 | III | 7½ | 46 | 26 | 57 | ..... | ..... | 0.14 | 0.50 | ..... | + + + | + + | 190 | 110 | Neuroretinitis. Slight edema. Slight improvement after Cesarean. |
| 3-A. P. | 33 | II | 8 | 45 | 28 | 62 | 4.8 | 2.8 | 0.12 | 0.47 | 43 | + + + + | + + | ..... | ..... | Neuroretinitis. No edema. Delivered by forceps. Improvement slight. |
| 4-M. C. | 35 | IV | 7 | 29 | 15 | 51 | 5.3 | 2.6 | 0.14 | 0.52 | ..... | + + + + | − | 200 | 120 | Neuroretinitis. Marked edema. No convulsions. Cesarean. Improved. |
| **Hepatic Toxemias** | | | | | | | | | | | | | | | | |
| 1-C. B. | 22 | I | 3 | 34 | 12 | 33 | 3.0 | 1.9 | 0.12 | 0.47 | 28 | + | − | 130 | 90 | Pernicious vomiting. No convulsions. |
| 2-N. O. | 27 | II | 3 | 56 | 8 | 15 | ..... | 1.6 | 0.14 | 0.41 | 42 | + | − | 110 | 70 | Pernicious vomiting. No convulsions. |
| 3-B. W. | 25 | I | 9 | 30 | 5 | 16 | 8.5 | ..... | 0.10 | 0.63 | 16 | + + + | + | 165 | 100 | Convulsions began 3 hours postpartum. |
| 4-M. B. | 21 | I | 9 | 36 | 11 | 32 | 4.8 | 1.9 | 0.15 | ..... | ..... | + + | − | 195 | 105 | Convulsions began 1 hour postpartum. Died. |
| 5-J. H. | 20 | I | 9 | 37 | 10 | 27 | 3.8 | ..... | 0.09 | 0.59 | 42 | + + | − | 180 | 120 | Convulsions began 2 days postpartum. |
| 6-H. S. | 22 | I | 9 | 48<br>26 | 15<br>13 | 32<br>50 | 7.3<br>3.5 | 1.8<br>2.1 | 0.13<br>0.12 | 0.46<br>0.50 | 28<br>40 | + + + +<br>+ | + +<br>− | 190<br>100 | 100<br>65 | Convulsions began 2 hours postpartum.<br>14 days later. Improved. |

TABLE I—CONTINUED

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-L. T. | 33 | II | 9 | 58 | 11 | 17 | 4.3 | ..... | ..... | ..... | ..... | ++ | + | 185 | 115 | Convulsions began 1 hour post partum. |
| 8-M. E. | 27 | I | 7 | 34 | 13 | 36 | 11.0 | 2.5 | 0.13 | ..... | 38 | +++ | + | 210 | 140 | Severe convulsions. Stillbirth. Died. |
| 9-Y. H. | 28 | I | 7½ | 35 | 9 | 27 | 6.8 | ..... | 0.12 | ..... | 38 | ..... | ..... | ..... | ..... | Severe convulsions. Stillbirth. |
| | | | | 23 | 12 | 51 | 2.5 | ..... | 0.09 | ..... | 53 | ..... | ..... | ..... | ..... | 5 days later. Improved. |
| 10-M. B. | 29 | III | 9 | 36 | 9 | 22 | 4.5 | 1.9 | 0.12 | 0.52 | 26 | +++ | + | 175 | 105 | Convulsions. Edema. Stillbirth. |
| 11-B. R. | 33 | I | 9 | 36 | 12 | 34 | 3.6 | 1.7 | 0.17 | 0.47 | 34 | ++ | − | 140 | 85 | Mild convulsions. Fetus toxic. |
| 12-H. B. | 32 | III | 7 | 37 | 14 | 34 | 6.5 | ..... | 0.10 | 0.58 | 40 | ++++ | ++ | ..... | ..... | Severe convulsions. Stillbirth. |
| 13-D. M. | 22 | I | 8 | 37 | 11 | 29 | 5.0 | ..... | 0.14 | 0.47 | 37 | +++ | + | ..... | ..... | Severe convulsions. Fetus toxic. |
| 14-F. H. | 27 | I | 7 | 38 | 10 | 29 | 3.4 | ..... | 0.10 | 0.61 | 12 | ++ | + | ..... | ..... | Severe convulsions. Edema. Died. |
| 15-E. R. | 32 | I | 7½ | 39 | 12 | 30 | 7.5 | 2.3 | 0.13 | 0.47 | 40 | ++++ | + | 150 | 115 | Severe convulsions. Stillbirth. |
| 16-R. W. | 24 | II | 8 | 40 | 6 | 16 | 6.8 | 2.5 | 0.13 | 0.55 | 36 | ++++ | +++ | 164 | 100 | Severe convulsions. Slight edema. Stillbirth. |
| 17-E. P. | 20 | I | 7½ | 40 | 6 | 16 | 6.9 | 2.2 | 0.12 | 0.52 | 30 | +++ | + | 185 | 100 | Severe convulsions. Slight edema. Stillbirth. |
| 18-N. L. | 24 | II | 7 | 47 | 14 | 29 | 5.4 | ..... | 0.12 | 0.63 | ..... | ++++ | ++ | 220 | 118 | Severe convulsions. Marked edema. Stillbirth. |
| 19-A. B. | 21 | I | 9 | 50 | 9 | 18 | 5.6 | 2.2 | 0.18 | 0.52 | 21 | +++ | ++ | 160 | 88 | Very severe convulsions. Fetus toxic. |
| 20-A. C. | 18 | I | 5 | 64 | 18 | 28 | 7.5 | 1.7 | 0.12 | 0.50 | 26 | ++++ | ++ | 195 | 145 | Very severe convulsions. Stillbirth. |
| | | | | 90 | 43 | 47 | 3.2 | 3.7 | ..... | 0.61 | 52 | ++++ | ++ | 175 | 135 | 8 days later. No improvement. Edema. |
| 21-M. R. | 21 | I | 7 | 56 | 22 | 38 | 6.8 | 2.7 | 0.11 | 0.52 | 20 | ++++ | ++ | 195 | 110 | Very severe convulsions. Edema. Stillbirth. |
| 22-B. S. | 26 | I | 6½ | 64 | 22 | 32 | 8.6 | 2.5 | 0.10 | 0.42 | ..... | ++++ | ++ | 210 | 110 | Very severe convulsions. Stillbirth. |

** The authors take pleasure in acknowledging their indebtedness to Dr. Broadhead of Harlem Hospital, Dr. Oastler, of Lincoln Hospital, and Dr. Telfair of Fordham Hospital, for their cooperation, and for the privilege of using the material in these institutions. The examination of the eye grounds have been made by Dr. Martin Cohen.

tion), reported the average nonprotein nitrogen to be 25 mg., 38 per cent of which was urea nitrogen. Losee and Van Slyke[6] found the nonprotein nitrogen in 10 cases of eclampsia to range from 25 to 46 mg., the urea nitrogen from 10 to 26 mg., and the amino acid nitrogen 4.4 to 7.9 mg. No attempt, however, had been made to classify the cases examined.

The first step in the study of the toxemias of pregnancy, begun by the authors about one year ago, was to determine whether a fairly large and representative group of toxic pregnant cases showed any characteristic pathologic variation in the chemical composition of the blood from that observed in normal, pregnant women. Our studies included an analysis of the blood, for nonprotein and urea nitrogen, uric acid, creatinine, sugar, chlorides and carbon dioxide combining power, and an examination of the urine for protein and casts. The methods employed in the analysis of the blood were carried out as outlined by Myers.[16] A notation of the systolic and diastolic blood pressures and some of the more salient clinical features was also made. Women who had been under observation during the whole period of their gestation were selected, after careful examination by obstetricians, to serve as normal cases. The blood was drawn according to the technic of Myers,[16] from the controls after a twelve hour fast, and in the pathologic cases at the height of the toxic state. In some instances another specimen for comparison was obtained after a distinct clinical improvement was evident. The data collected point to certain definite conclusions, which it seems pertinent to present at the present time. In this paper we propose to demonstrate that the toxemias of pregnancy coming under our observation may be grouped in two classes; (a) nephritic toxemias, (b) hepatic toxemias. These two types of toxemia present changes in the chemical composition of the blood that are definite and characteristic.

## DISCUSSION OF DATA

The results of studies on 5 of the normal cases are presented in Table I. It will be observed that the nonprotein nitrogen here is at the low normal level or slightly decreased, (21 to 25 mg.) and corresponding to this there is a diminution in the concentration of the urea nitrogen (9 to 11 mg.). The urea nitrogen on the average forms 44 per cent of the nonprotein nitrogen. Our results in this particular, although at variance with the figures reported by Folin, are in conformity with those of Slemons and Morris, and in many instances with the findings of Caldwell and Lyle. The figures obtained for uric acid, creatinine and chlorides (of the whole blood) are well within normal limits. Normal blood sugar values were prevalent in all instances, with the exception of cases 1 and 2. Here slight hyperglycemias were noted. A definite decrease in the carbon

dioxide combining power of the blood plasma was found to be the rule in the last months of normal pregnancy. The maximum decrease was to 39 volumes per cent. This apparent drop in the reserve alkali of the blood although not accompanied by a ketonuria, was found to be associated with mild symptoms of dyspnea after physical exertion. It would appear from these findings and as well from the observations of Hasselbalch and Gammeltoft, of Losee and Van Slyke, and of White that a mild acidosis prevails during the last months of pregnancy. Finally, occasionally traces of protein were detectable in the urine. Casts, however, were never found.

Under the heading of nephritic toxemias we have grouped those cases that in their previous histories and in many of their clinical manifestations present definite evidence of a preexisting impairment of kidney function, either acute, or an exacerbation of a chronic condition. Here the renal insufficiency is not consequent to the pregnancy toxemia, but on the contrary it may have been a predisposing cause to the development of the toxemia. Of the 4 cases reported, the first 3 show an impairment of nitrogen elimination. It is obvious that the changes observed in blood of these cases are in accord with the variations typical of moderate or severe renal impairment in general. The nonprotein nitrogen was found to be greatly increased (45 to 106 mg.). A characteristic feature about these cases is that the urea nitrogen (51 to 67 per cent) constitutes a larger fraction of the nonprotein nitrogen than in normal blood. Such also is generally known to be the case in nonpregnant nephritics. Mosenthal and Hiller[17] have demonstrated that a selective action of the kidney maintains the urea nitrogen at a level of about 50 per cent of the total nonprotein nitrogen of the blood, but an impairment of renal function even of a slight degree may result in an increase in the percentage of the urea nitrogen. The retention of uric acid in the first case was very marked but only moderate in the third case, and the creatinine figures are but slightly above normal. Although these cases show a decrease in the carbon dioxide combining power of the blood plasma, the acidosis is not greater than in normal pregnancies.

Another type of toxemia of renal origin is represented by the fourth case. Here it will be observed that the nonprotein and urea nitrogen do not vary from the normal. The uric acid, however, is definitely increased (5.3 mg.). The chloride concentration of the whole blood was found to be 0.52 per cent. Myers and Short[18] have found the chlorides of the whole blood to range from 0.45 to 0.50 per cent in normal cases, whereas in parenchymatous nephritis with edema the chloride concentration is found to be from 0.52 to 0.60 per cent. The accumulated chlorides of the blood here, in spite of a salt-free diet, were coincident with a scanty output of urine containing a large amount of protein and a pronounced general anasarca which had

been progressing for four months previous to admission to the hospital. These findings indicate a definite impairment of chloride excretion, with but slight involvement of nitrogen elimination. This patient, although suffering from pronounced visual disturbances accompanied by headache and nausea, at no time had convulsions.

Hypertension was noted in all cases within this group and an examination of the fundi revealed the usual picture of albuminuric retinitis. Large amounts of protein and frequently casts had been observed in the urine for some time previous to coming under our observation. The first three cases developed severe convulsions, and in all cases there was but a slight general improvement following the termination of the pregnancy. It is evident, then, that in this type of toxemia, we are dealing with a more or less severe impairment of renal function, and the chemical changes observed in the blood must be attributed to this kidney insufficiency rather than to the pregnancy toxemia itself.

A study of the final 22 cases in the table, classified as hepatic toxemias, or true eclampsia, reveals an entirely distinct type of change in the composition of the blood. In general, the patients in this class are younger than those of the preceding group, and with 5 exceptions are primiparæ. In this regard it may be said also that the previous pregnancies of these multiparæ had been toxic, and were consequently prematurely terminated. Case 10 is, however, an exception. This patient had two living, healthy children. This group includes two cases of pernicious vomiting, and five of postpartum eclampsia.

Inspection of the table discloses that the nonprotein nitrogen is invariably above the high normal limit, and in some instances more than double that figure. The range of the values found is from 34 to 90 mg. On the other hand, the urea nitrogen in the first 19 cases is at the low normal level or markedly decreased, figures from 5 to 14 mg. being obtained. A remarkably low percentage of the nonprotein nitrogen is in the form of urea. The highest percentage found was 38 and the lowest 15. We believe that the high nonprotein nitrogen of which the urea nitrogen forms a small percentage is characteristic of pregnancy toxemias of the hepatic type, but at present we are not prepared to offer an explanation of this phenomenon. Although in the last three cases the urea nitrogen in the antepartum specimens is definitely increased above the normal, nevertheless the urea nitrogen constitutes a smaller fraction of the nonprotein nitrogen than in normal cases. These low percentages in the hepatic cases afford a striking contrast to the percentages obtained in the nephritic toxemias, although the figures for both the nonprotein and urea nitrogen are somewhat similar.

The increase in the concentration of uric acid (3 to 11 mg.) is very marked, and we are convinced, particularly significant. The results

obtained by Slemons and Bogert[19] are in accord with our findings. These authors, while reporting normal figures for uric acid in the blood in uncomplicated pregnancy, obtained values from 6 to 9 mg. in preeclampsia, eclampsia, and nephritis complicating pregnancy. Bauman, Hansman, Davis and Stevens[20] after a thorough study of renal function tests in a large series of cases, concluded that the uric acid concentration of the blood is the most delicate index of kidney function at our disposal. On numerous occasions, the fact has been established by Myers[21] and his coworkers that the normal uric acid concentration of the blood is 2 to 3 mg. and as the permeability of the kidney is lowered in the initial stages of renal impairment, this first becomes evident in the analysis of the blood, by high figures for uric acid. This retention of uric acid is a more reliable, and may be an earlier, indication of kidney involvement of the interstitial type than proteinuria or cylinduria. Later, as the condition progresses the urea accumulates, but as a rule there is no appreciable increase in the concentration of creatinine until the urea nitrogen has been doubled or more than doubled. The normal values for creatinine are from 1-2 mg., and a retention of creatinine above 3.5 mg. denotes a severe disturbance of kidney function. The order of retention of these nitrogenous wasted products is apparently dependent upon the ability of the kidney to excrete them. Myers and Fine[22] have shown that the normal kidney concentrates the creatinine 100 times, the urea 80 times, but the uric acid only 20 times. On reference to the table it will be evident that the high values for uric acid are accompanied by the occurrence of protein and casts in the urine. There can be no doubt but that this increase in the concentration of uric acid must be attributed to a mild impairment of renal function consequent to the toxemia. In the last two cases, the urea nitrogen has been increased to 22 mg. Folin states that the maximum concentration of urea nitrogen for strictly normal persons is 14 to 15 mg., and Kast and Wardell[23] after a careful study of the significance of the concentration of urea nitrogen in the blood in various conditions, conclude that values of 20 mg. or more have a pathologic significance. It is obvious then that the impairment of the functioning power of the kidneys has advanced in these two instances so far as not only to inhibit the excretion of uric acid, but as well of the urea. The observations on Case 20 are of interest in this connection. Here in the antepartum specimen of blood, obtained when convulsions lasting 3 to 4 minutes were rapidly succeeding one another, the nonprotein nitrogen was found to be 64 mg., the urea nitrogen 18 mg., the uric acid 7.5 mg., and the creatinine 1.7 mg., the urea nitrogen constituting only 28 per cent of the nonprotein nitrogen. The convulsions ceased after the evacuation of the uterus, but there was no other improvement. The patient continued in a semicomatose state, general edema developed

and there was but a slight drop in the blood pressure. Another specimen of blood was obtained 8 days after parturition when the patient appeared to be in a critical condition. There were, however, no convulsions. At this time, the nonprotein nitrogen had risen to 90 mg., the urea nitrogen to 43 mg., the uric acid had dropped to 3.2 mg., but the concentration of creatinine was increased to 3.7 mg. It is pertinent to note that in this second specimen of blood the urea nitrogen forms a much larger portion of the nonprotein nitrogen than in the antepartum specimen. Obviously the disturbance of kidney function which was indicated by the increased uric acid in the antepartum blood has progressed, despite the termination of the pregnancy, to such an extent that a marked retention of urea, and a mild accumulation of creatinine result. These findings confirm the observation of Ewing and Wolf that toxemia is a frequent cause of nephritis developing in pregnancy. Persistent toxemia tends to progressively involve the kidneys.

No variation from normal was noted in the concentration of creatinine except in the postpartum blood of Case 20. In some instances there was a very definite increase in the chlorides of the blood, and this increase was found to be associated with a more or less pronounced edema. In general it may be said that there is a mild hyperglycemia. Morris[24] has shown that a rise in the blood sugar is evident after convulsions in eclamptic toxemias. The slight increase in the blood sugar observed by us may be due to this factor, inasmuch as the specimens of blood were obtained at the height of the toxemia.

The decrease in the carbon dioxide combining power of the blood (42 to 12 volumes per cent) is particularly striking, indicating in most cases a severe acidosis. In this respect, the hepatic toxemias differ markedly from the nephritic toxemias. The rise in the carbon dioxide combining power in the second specimen of Case 20 is due to alkali therapy. Where surgical interference is contemplated, measures to relieve this acidosis are of prime importance. Among the cases recorded, there have been three deaths due in all probability to postoperative acidosis.

With the exception of the two cases of pernicious vomiting, a hypertension is generally noted. The chemical changes, however, found in pernicious vomiting are analogous to those in postpartum eclampsia, and eclampsia with gravid uterus. These findings are of interest in view of the statement of Ewing[25] that pernicious vomiting and eclampsia are identical in nature and have the same etiology. A general clinical improvement appears to be consequent to a resumption of the normal composition of the blood. In Case 9 the toxic symptoms disappeared 5 days after delivery, and at this time the blood was found to be normal. But it was only after a period of fourteen days that Case 6

presented evidence of improvement. The fundi in all cases examined proved to be normal.

Fig. 1 presents graphically the average values for nonprotein and urea nitrogen and uric acid in cases of normal pregnancy, chronic nephritis, nephritic toxemias and hepatic toxemias. It will be noted that in the nephritic toxemias the relation of the urea nitrogen to the nonprotein is analogous to that characteristic of chronic nephritis,

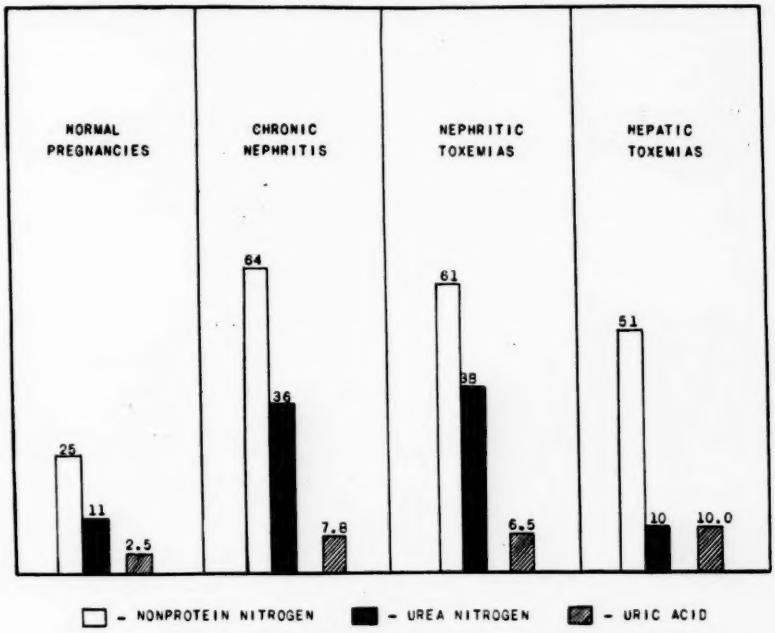


Fig. 1.—Diagrammatic illustration showing blood findings in pregnancy.

but in the hepatic toxemias the disturbance of this relation is very striking. It will also be observed that the average value for uric acid in the hepatic toxemias is greater than in chronic nephritis or the nephritic toxemias.

## CONCLUSIONS

1. Low values for nonprotein and urea nitrogen are found in normal pregnancy. The urea nitrogen constitutes about 44 per cent of the nonprotein nitrogen. No variation is found in the uric acid, creatinine, chloride or sugar concentration of the blood of normal pregnant women from that observed in nonpregnant women. A slight decrease in the carbon dioxide combining power of the blood plasma characterizes the last months of normal pregnancy.

2. The chemical changes in the blood in the nephritic toxemias are typical of impairment of kidney function in general. There is an increase in nonprotein and urea nitrogen, and more than 50 per cent

of the nonprotein nitrogen is in the form of urea nitrogen. Some of the clinical symptoms, also point to a more or less severe nephritis. At most but a slight improvement follows the emptying of the uterus.

3. Analogous chemical changes are found in the blood in pernicious vomiting, postpartum eclampsia, and eclampsia with gravid uterus. The nonprotein nitrogen is markedly increased, whereas the urea nitrogen is at the low normal limit or decreased, constituting 15 to 38 per cent of the nonprotein nitrogen. A definite increase in uric acid is found, which is due to an impairment of renal function. In some cases the disturbance of the kidney function resulted in a retention of urea nitrogen in addition to the uric acid. In this type of toxemia the involvement of renal function results from the toxemia. A moderate or severe acidosis is observed in all cases. A prompt improvement, judged from a clinical standpoint and from the chemical composition of the blood in most instances follows the evacuation of the uterus.

## REFERENCES

[1]München med. Wchnschr., 1906, liii, 297. [2]Biochem. Ztschr., 1915, lxviii, 207. [3]Jour. Cancer Research, 1917, ii, 179. [4]Lancet, London, 1920, ii, 1248. [5]The Principles of Acidosis and Clinical Methods for Its Study, Cambridge, Mass., 1917. [6]Am. Jour. Med. Sc., 1917, liii, 94. [7]Am. Jour. Obst., 1907, lv, 289. [8]Bull. Johns Hopkins Hosp., 1916, xxvii, 121. [9]Bull. Johns Hopkins Hosp., 1906, Analysis of Blood, St. Louis, 1921, C. V. Mosby Co. [17]Jour. Urol., 1917, 1, 75. xvii, 71. [10]Jour. Am. Med. Assn., 1912, lix, 1522. [11]Bull. Johns Hopkins Hosp., 1914, xxv, 147. [12]Arch. Int. Med., 1910, v, 61. [13]Jour. Am. Med. Assn., 1917, lxix, 1209. [14]Slemons, J. M., and Morris, W. H., Bull. Johns Hopkins Hosp., 1916, xxvii, 343. [15]Am. Jour. Obst. and Gyn., ii, 17. [16]Practical Chemical Analysis of Blood, St. Louis, 1921, C. V. Mosby Co. [17]Jour. Urol., 1917, 1, 75. [18]Jour. Biol. Chem., 1920, xliv, 47. [19]Jour. Biol. Chem., 1917, xxxii, 63. [20]Arch. Int. Med., 1919, xxiv, 70. [21]Arch. Int. Med., 1916, xvii, 570. [22]Jour. Biol. Chem., 1919, xxxvii, 239. [23]Arch. Int. Med., 1918, xxii, 581. [24]Bull. Johns Hopkins Hosp., 1917, xxviii, 140. [25]Am. Jour. Obst. and Dis. Wom. and Childr., 1905, li, 145.

203 East Twentieth Street.
Fordham University, Fordham, N. Y.

# THE BLOOD CHEMISTRY IN NORMAL AND ABNORMAL PREGNANCY*

By William E. Caldwell, M.D., and Wm. G. Lyle, M.D., New York, N. Y.

*From the Department of Obstetrics, Columbia University and the Harriman Research Laboratory (R. L. Gerry Fund.)*

TO THOSE interested in investigating eclampsia and its allied disturbances a new approach has been opened by the recent advent of microchemical methods for the determination of the several nonprotein nitrogen constituents of the blood. In this paper we present for consideration the results obtained from a chemical analysis for these consfituents as they are found, first, in normal pregnancy and then in toxemias of pregnancy and in eclampsia.

In the normal cases the blood specimens were obtained from the antepartum clinic of the New York Nursery and Child's Hospital. The blood of the cases of eclampsia and toxemia came from the maternity service of Bellevue Hospital. The chemical analyses were carried out at the Harriman Research Laboratory by chemists who have been using practically the same technic since 1916.†

The figures in our tables represent milligrams per hundred cubic centimeters of blood.

As a result of more than 5000 chemical examinations, the Harriman Research Laboratory has come to regard the following nitrogen partition (mg. per hundred c.c. of blood) as a normal blood picture in a healthy nonpregnant woman:

| N.P.N. | UREA N. | CREATININ | URIC ACID | U.N. TO N.P.N. |
|---|---|---|---|---|
| 35 mg. or less | 18 mg. or less | 2 mg. or less | 3 mg. or less | 50 per cent |

These figures correspond with the standards generally accepted by other investigators.

In Tables I, II and III are given the blood pictures of 150 pregnant women, all of whom were clinically free of disease, with negative Wassermann reactions. The systolic blood pressures were under 130 mm. of mercury. The urines were free from albumin and casts. They all went through a normal labor and puerperium.

---

*Read at a meeting of the Section on Obstetrics and Gynecology, Academy of Medicine, February 25, 1921.

†The following analytical methods were employed:
Nonprotein nitrogen.—Greenwald: Jour. Biol. Chem., 1915, xxi, 61.
Urea nitrogen—Van Slyke and Cullen: Jour. Biol. Chem., 1914, xix, 211.
Creatinine and sugar.—Myers and Bailey: Jour. Biol. Chem., 1916, xxix, 147.
Uric acid.—Benedict: Jour. Biol. Chem., 1915, xx, 629.

TABLE I

NORMAL PREGNANCY

| Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. | Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | 9.40 | 1.20 | 0.80 | | 29 | 6 | 30.20 | 12.30 | 1.10 | 2.47 | 0.41 |
| 2 | 2 | 34.60 | 15.90 | 1.30 | | 0.46 | 30 | 6 | 33.10 | 14.40 | 0.74 | 0.68 | 0.44 |
| 3 | 2 | 37.40 | 18.10 | 1.10 | 1.86 | 0.48 | 31 | 6 | 31.50 | 10.10 | 1.25 | 0.82 | 0.32 |
| 4 | 2 | 33.60 | 15.40 | 0.93 | 2.11 | 0.46 | 32 | 6 | 30.20 | 7.25 | 0.79 | 2.40 | 0.24 |
| 5 | 3 | 37.40 | 12.30 | 0.91 | 0.80 | 0.33 | 33 | 6 | 31.00 | 12.20 | 1.00 | | 0.39 |
| 6 | 3 | 20.20 | 8.10 | 1.20 | 0.82 | 0.40 | 34 | 6 | 27.40 | 7.92 | | 1.30 | 0.29 |
| 7 | 4 | 36.00 | 14.50 | 1.10 | 1.30 | 0.40 | 35 | 6 | 21.00 | 10.20 | 0.73 | 1.00 | 0.49 |
| 8 | 4 | 26.60 | 11.50 | 1.10 | 1.74 | 0.43 | 36 | 6 | 21.00 | 10.00 | 0.92 | | 0.48 |
| 9 | 4 | 27.00 | 10.90 | 1.20 | 2.00 | 0.40 | 37 | 6 | 31.00 | 10.10 | 0.67 | 0.79 | 0.33 |
| 10 | 5 | 35.70 | 11.80 | 1.40 | 3.50 | 0.33 | 38 | 6 | 28.00 | 11.50 | 1.00 | 2.00 | 0.41 |
| 11 | 5 | 38.20 | 18.70 | | | 0.49 | 39 | 6 | 29.50 | 12.90 | 1.40 | 0.95 | 0.44 |
| 12 | 5 | 30.20 | 11.50 | 1.10 | 0.80 | 0.38 | 40 | 6 | 31.70 | 11.90 | 1.20 | 1.30 | 0.38 |
| 13 | 5 | 27.00 | 3.60 | 1.00 | 1.72 | 0.13 | 41 | 6 | 32.30 | 13.30 | 1.50 | 2.66 | 0.41 |
| 14 | 5 | 23.00 | 10.80 | | | 0.47 | 42 | 6 | 33.10 | 18.00 | 1.10 | 2.18 | 0.54 |
| 15 | 5 | 23.50 | 9.35 | 0.98 | 1.18 | 0.40 | 43 | 6 | 26.00 | 12.20 | 1.07 | 1.70 | 0.47 |
| 16 | 5 | 27.00 | 12.90 | 1.10 | 1.34 | 0.48 | 44 | 6 | 18.00 | 7.90 | 0.69 | | 0.44 |
| 17 | 5 | 25.30 | 8.10 | 1.10 | 1.89 | 0.32 | 45 | 6 | 24.50 | 10.10 | | | 0.41 |
| 18 | 6 | 29.00 | 10.80 | 1.05 | 0.88 | 0.37 | 46 | 6 | 31.00 | 13.20 | 1.20 | 0.68 | 0.43 |
| 19 | 6 | 30.20 | 11.30 | 1.87 | 1.08 | 0.37 | 47 | 6 | 26.90 | 12.20 | 0.81 | 2.70 | 0.45 |
| 20 | 6 | 31.50 | 7,21 | 0.82 | 0.57 | 0.23 | 48 | 6 | 27.00 | 11.70 | 1.00 | 2.13 | 0.43 |
| 21 | 6 | 31.60 | 7.92 | 0.87 | | 0.25 | 49 | 6 | 28.50 | 12.40 | 0.71 | 2.88 | 0.44 |
| 22 | 6 | 26.60 | 6.13 | 0.87 | 0.82 | 0.23 | 50 | 6 | 26.90 | 11.00 | 1.00 | 1.62 | 0.41 |
| 23 | 6 | 29.50 | 7.70 | 0.91 | 1.68 | 0.26 | 51 | 6 | 26.40 | 10.60 | 0.90 | 2.41 | 0.40 |
| 24 | 6 | 24.50 | 5.75 | 0.98 | 1.00 | 0.24 | 52 | 6 | 31.00 | 13.70 | 0.67 | 2.37 | 0.44 |
| 25 | 6 | 26.60 | 11.00 | 0.88 | 1.26 | 0.41 | 53 | 6 | 31.20 | 13.50 | 1.10 | 1.00 | 0.43 |
| 26 | 6 | 38.20 | 12.00 | 1.50 | 0.99 | 0.31 | 54 | 6 | 27.80 | 12.40 | 0.98 | 1.30 | 0.45 |
| 27 | 6 | 24.50 | 9.40 | 0.95 | 2.10 | 0.38 | 55 | 6 | 29.60 | 10.70 | 0.57 | 0.95 | 0.36 |
| 28 | 6 | 36.00 | 10.50 | 1.10 | 1.00 | 0.29 | Ave. | | 29.19 | 11.21 | 1.04 | 1.53 | 0.39 |

TABLE II

NORMAL PREGNANCY

| Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. | Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 26.70 | 12.20 | 1.50 | 2.50 | 0.46 | 27 | 7 | 29.50 | 9.00 | 1.30 | 2.24 | 0.31 |
| 2 | 7 | 29.00 | 11.50 | 0.80 | | 0.40 | 28 | 7 | 41.63 | 5.05 | | | 0.12 |
| 3 | 7 | 23.00 | 10.10 | 0.79 | 0.45 | 0.44 | 29 | 7 | 28.10 | 8.09 | 0.89 | | 0.29 |
| 4 | 7 | 36.00 | 14.60 | 1.00 | 2.10 | 0.41 | 30 | 7 | 39.50 | 9.72 | 0.97 | 0.95 | 0.25 |
| 5 | 7 | 23.70 | 8.50 | 2.80 | 3.00 | 0.36 | 31 | 7 | 29.20 | 12.90 | 0.87 | 1.14 | 0.44 |
| 6 | 7 | 27.40 | 9.80 | 1.20 | 2.10 | 0.36 | 32 | 7 | 31.30 | 17.62 | 1.04 | 1.44 | 0.56 |
| 7 | 7 | 24.50 | 10.80 | 0.69 | | 0.44 | 33 | 7 | 32.40 | 10.01 | 1.07 | 3.14 | 0.31 |
| 8 | 7 | 33.20 | 13.70 | 1.10 | 1.20 | 0.41 | 34 | 7 | 35.20 | 9.00 | 0.97 | 0.91 | 0.25 |
| 9 | 7 | 36.00 | 19.60 | 0.80 | | 0.54 | 35 | 7 | 27.40 | 16.20 | 1.02 | | 0.59 |
| 10 | 7 | 33.10 | 14.40 | 2.00 | 2.94 | 0.44 | 36 | 7 | 31.70 | 9.20 | 0.92 | 2.29 | 0.29 |
| 11 | 7 | 28.80 | 10.80 | 1.10 | 2.60 | 0.38 | 37 | 7 | 32.00 | 18.39 | 0.75 | 1.47 | 0.58 |
| 12 | 7 | 33.80 | 10.00 | 1.00 | 0.99 | 0.30 | 38 | 7 | 23.00 | 12.90 | 0.75 | 1.10 | 0.56 |
| 13 | 7 | 33.80 | 14.90 | 1.00 | 2.00 | 0.44 | 39 | 7 | 28.80 | 12.90 | 1.10 | 1.00 | 0.45 |
| 14 | 7 | 21.60 | 9.20 | 1.20 | | 0.43 | 40 | 7 | 38.50 | 11.20 | 0.86 | 1.02 | 0.29 |
| 15 | 7 | 28.80 | 10.10 | 0.75 | | 0.35 | 41 | 7 | 23.80 | 7.94 | 0.86 | 0.50 | 0.33 |
| 16 | 7 | 29.50 | 12.60 | 1.05 | 1.98 | 0.43 | 42 | 7 | 27.00 | 10.20 | 1.20 | 4.00 | 0.38 |
| 17 | 7 | 20.10 | 10.80 | 0.59 | | 0.54 | 43 | 7 | 24.80 | 7.90 | 0.74 | 1.93 | 0.32 |
| 18 | 7 | 26.60 | 11.50 | 1.07 | 1.70 | 0.43 | 44 | 7 | 26.00 | 9.00 | 0.62 | 1.89 | 0.35 |
| 19 | 7 | 31.70 | 10.10 | 1.00 | ..... | 0.32 | 45 | 7 | 32.40 | 11.18 | 0.87 | 0.95 | 0.35 |
| 20 | 7 | 20.80 | 8.70 | 1.30 | 2.44 | 0.42 | 46 | 7 | 23.40 | 6.45 | 0.73 | 2.76 | 0.28 |
| 21 | 7 | 28.80 | 8.65 | 0.87 | 0.94 | 0.30 | 47 | 7 | 30.20 | 9.70 | 1.25 | 1.17 | 0.32 |
| 22 | 7 | 33.80 | 11.50 | 1.10 | 1.04 | 0.34 | 48 | 7 | 27.30 | 11.70 | 0.88 | 1.87 | 0.43 |
| 23 | 7 | 26.70 | 11.20 | 0.77 | 0.74 | 0.42 | 49 | 7 | 26.90 | 12.20 | 0.81 | 2.70 | 0.45 |
| 24 | 7 | 30.20 | 12.00 | 1.16 | 2.22 | 0.40 | 50 | 7 | 27.90 | 12.40 | 0.98 | 1.90 | 0.44 |
| 25 | 7 | 28.10 | 11.50 | 0.89 | 1.11 | 0.41 | 51 | 7 | 34.10 | 15.90 | 0.71 | 2.14 | 0.47 |
| 26 | 7 | 27.70 | 15.10 | 1.30 | 2.88 | 0.55 | Ave. | | 29.23 | 11.31 | 1.03 | 1.78 | 0.39 |

TABLE III

NORMAL PREGNANCY

| Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. | Case | Month | BLOOD ANALYSIS MG. PER 100 C. C. N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | RATIO: U. NIT. TO N. P. N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 26.00 | 10.00 | 1.30 | 1.90 | 0.39 | 23 | 8 | 32.40 | 12.95 | 0.85 | 3.33 | 0.40 |
| 2 | 8 | 27.40 | 13.90 | 1.30 | 2.00 | 0.51 | 24 | 8 | 29.60 | 10.10 | 0.84 | 2.53 | 0.34 |
| 3 | 8 | 33.00 | 13.70 | 1.40 | | 0.42 | 25 | 8 | 28.00 | 10.40 | 0.89 | 0.84 | 0.37 |
| 4 | 8 | 25.10 | 9.70 | 1.10 | 3.20 | 0.39 | 26 | 8 | 30.20 | 12.40 | 0.98 | 2.87 | 0.41 |
| 5 | 8 | 31.70 | 14.40 | 1.35 | 2.32 | 0.45 | 27 | 8 | 36.40 | 14.40 | 0.84 | 1.15 | 0.40 |
| 6 | 8 | 30.28 | 8.64 | 1.50 | | 0.29 | 28 | 8 | 29.20 | 11.15 | 1.08 | 2.37 | 0.38 |
| 7 | 8 | 33.20 | 13.70 | 1.30 | 3.48 | 0.41 | 29 | 8 | 33.10 | 7.70 | 1.10 | 0.54 | 0.23 |
| 8 | 8 | 21.60 | 10.00 | 1.60 | 3.30 | 0.46 | 30 | 8 | 27.00 | 12.60 | 1.30 | 1.24 | 0.47 |
| 9 | 8 | 31.00 | 12.20 | 1.00 | | 0.39 | 31 | 8 | 27.40 | 11.70 | 1.10 | 1.90 | 0.43 |
| 10 | 8 | 29.50 | 14.40 | 1.10 | | 0.49 | 32 | 8 | 27.50 | 11.00 | 1.20 | 1.60 | 0.40 |
| 11 | 8 | 29.50 | 12.90 | 1.20 | | 0.44 | 33 | 9 | 27.00 | 4.70 | 0.85 | | 0.17 |
| 12 | 8 | 34.20 | 11.50 | | 1.33 | 0.34 | 34 | 9 | 28.10 | 9.20 | 0.60 | | 0.33 |
| 13 | 8 | 32.10 | 13.80 | 0.99 | 1.00 | 0.43 | 35 | 9 | 34.50 | 11.50 | 0.80 | 1.20 | 0.33 |
| 14 | 8 | | 12.96 | 0.75 | 1.00 | | 36 | 9 | 31.00 | | 1.40 | 1.90 | |
| 15 | 8 | 31.70 | 15.10 | 1.30 | 2.70 | 0.48 | 37 | 9 | 38.10 | 9.40 | 0.77 | | 0.25 |
| 16 | 8 | 33.60 | 17.30 | 1.20 | 2.60 | 0.51 | 38 | 9 | 34.50 | 11.00 | 1.30 | 2.10 | 0.32 |
| 17 | 8 | 42.50 | 15.30 | 1.30 | 1.10 | 0.36 | 39 | 9 | 21.70 | 10.70 | 1.10 | 3.10 | 0.49 |
| 18 | 8 | 28.00 | 11.50 | 0.86 | 1.00 | 0.41 | 40 | 9 | 39.00 | 14.40 | 1.50 | 1.30 | 0.37 |
| 19 | 8 | 29.50 | | 0.89 | 2.42 | | 41 | 9 | 41.80 | 21.60 | 0.98 | 2.50 | 0.52 |
| 20 | 8 | 25.90 | 9.90 | 0.89 | 0.93 | 0.38 | 42 | 9 | 38.20 | 21.60 | | | 0.57 |
| 21 | 8 | 30.20 | 7.20 | 1.10 | 2.30 | 0.24 | 43 | 9 | 26.70 | 8.70 | 1.20 | 2.84 | 0.33 |
| 22 | 8 | 24.80 | 8.65 | 0.82 | 0.50 | 0.35 | 44 | 9 | 35.60 | 16.20 | 1.10 | | 0.45 |
| Ave. | 8 | 30.05 | 11.97 | 1.11 | 1.91 | 0.40 | Ave. | 9 | 33.02 | 12.64 | 1.05 | 2.13 | 0.38 |

The averages of the several nitrogen partitions for the entire series were as follows:

| N.P.N. | UREA N. | CREATININ | URIC ACID | U.N. TO N.P.N. |
|---|---|---|---|---|
| 29.69 | 11.51 | 1.05 | 1.73 | 39 per cent |

A grouping of our cases according to the period of pregnancy disclosed no significant differences between the successive periods; although the twelve cases grouped in the ninth month show a slightly higher average for N.P.N., urea N. and uric acid.

Hitherto, the largest series of chemical analyses of blood taken during a normal pregnancy is reported by Folin[1] and comprise one hundred cases. This investigator, while not giving the figures for the individual determinations, states that the total N.P.N. in the great majority of his cases was under 30 mg.; and the urea nitrogen, 5 to 9 mg. Most other investigators have found slightly higher limits for urea nitrogen. In other respects it has been shown that the blood picture in normal pregnancy does not vary definitely from that of the non-pregnant individual. We refer especially to the reports of Farr and Williams,[2] Slemons and Morris,[3] Slemons and Bogert[4] and Losee.[5] The amino-nitrogen content of the blood has been studied by Morse,[6] Losee and Van Slyke[7] and others, who have found that the level of this nitrogen remains undisturbed by pregnancy.

In the 150 cases of this series the average ratio between urea N. and N.P.N. is 39 per cent. This is higher than that found by Folin (20 to 35 per cent); but it is lower than that reported by some other in-

vestigators. Compared with the blood of normal nonpregnant women, the urea N., in pregnancy, is maintained at a definitely lower level. Murlin and Bailey,[8] Wilson[9] and others, in their studies of the metabolism of pregnancy, have found both in women and in animals, a distinct nitrogen retention, especially in the latter weeks of pregnancy. Assuming the nitrogen retention to be at the expense of urea nitrogen, we can understand a lowered urea excretion. But this should in no way affect the blood-urea level; since this level we understand, is regulated by the threshold of permeability of the kidneys. The diminished ratio of the urea N. to the total N.P.N. increases the undetermined nitrogen factor. This offers an interesting field of speculation to students of protein metabolism. Unfortunately, in this series, we did not determine aminonitrogens routinely. In the few cases examined, however, our figures correspond with those of Morse,[6] Van Slyke and Losee.[7] Our failure to make these examinations regularly, deprives us of essential data for estimating the undetermined nitrogen.

Next in interest to the ratio of urea N. to N.P.N. is perhaps the comparison of the maternal and the fetal bloods at the end of labor. We have found (as given in Table IV) the N.P.N., urea N., creatinine and uric acid in the two circulations at the end of labor practically identical. For N.P.N. and urea N. this result is confirmed by Slemons and Morris;[3] for uric acid by Slemons and Bogert;[4] for creatinine by Plass.[10] Manifestly, for these substances, the placental interchange represents a simple process of diffusion. For the aminonitrogens, however, both Morse[6] and Rabinovitch[11] have found a definite increase in the fetal over the maternal blood content; although Morel and Mauriquand[12] in four analyses found no such difference. If this increase be accepted, it might be explained as a provision for protecting the fetus from nitrogen starvation. Such a theory, however, carries with it the assumption of absorptive properties on the part of the placenta; and also exempts the aminonitrogens from the operation of the diffusion principle applicable to the other nitrogenous constituents.

Table IV further shows that in cases of normal pregnancy the nitrogen partitions of maternal blood at the end of labor do not differ materially from those found during the latter weeks of pregnancy. Neither does any significant difference appear in cases of primiparæ and multiparæ. Our high uric acids occur with definite complications; or at least with clinical deviations from the normal, namely, increased blood pressure, albuminuria or multiple births. Slemons and Bogert[4] found a marked increase in uric acid in primiparae, in one instance this purin reaching as high as 8 mg. per hundred c.c. We cannot accept their suggestion that the increase may be the effect of the muscular effort of labor; we must rather regard this retention as due to the renal insufficiency that frequently develops in the latter weeks of pregnancy

TABLE IV

BLOOD PICTURES AT END OF NORMAL LABOR

| CASE | PARITY | N. P. N. | UREA N. | CREAT. | URIC A. | SUGAR | U. N. TO N. P. N. | B. P. | URINE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | P. | 26.5 | 11.7 | 0.90 | 2.78 | 0.11 | 0.44 | 120/80 | Neg. |
| 2 | P. | 33.4 | 15.7 | 0.70 | 3.37 | 0.10 | 0.47 | 125/80 | Neg. |
| | Fetus | N. B.* | N. B.* | 0.64 | 3.51 | 0.082 | ..... | ..... | ..... |
| 3 | P. | 28.9 | 13.8 | 0.70 | 4.44 | 0.085 | 0.48 | 120/80 | Neg. |
| | Fetus | 29.1 | 13.8 | 0.67 | N. B. | 0.087 | ..... | ..... | ..... |
| 4 | P. | 21.9 | 7.0 | 0.91 | 2.15 | 0.087 | 0.32 | 120/88 | Neg. |
| 5 | P. | 27.0 | 11.6 | 1.40 | 2.85 | 0.11 | 0.43 | 110/60 | Trace Alb. |
| 6 | P. | 25.3 | 9.0 | 0.95 | 4.28 | 0.080 | 0.36 | 140/90 | Neg. |
| 7 | P. | 25.0 | 8.3 | 1.10 | 3.42 | 0.10 | 0.33 | 150/100 | Trace Alb. |
| | Fetus | 25.0 | 8.3 | 1.10 | 3.08 | 0.10 | ..... | ..... | ..... |
| 8 | P. | 26.9 | 11.0 | 1.40 | 1.92 | 0.10 | 0.41 | Under 120–syst. | Neg. |
| | Fetus | 27.0 | 11.0 | 1.40 | 1.90 | 0.10 | ..... | ..... | ..... |
| 9 | P. | 26.4 | 9.68 | 1.30 | 1.40 | 0.10 | 0.37 | Under 120–syst. | Neg. |
| | Fetus | 26.0 | 9.7 | 1.35 | 1.50 | 0.10 | ..... | ..... | ..... |
| 10 | P. | 25.9 | 10.3 | 1.00 | 2.27 | 0.10 | 0.40 | Under 120–syst. | Neg. |
| | Fetus | 25.5 | 10.3 | 1.00 | 2.30 | 0.09 | ..... | ..... | ..... |
| Ave. | P. | 26.72 | 10.81 | 1.03 | 2.89 | ..... | ..... | ..... | ..... |
| 11 | M. | 36.9 | 19.1 | 1.30 | 3.02 | 0.12 | 0.52 | ..... | ..... |
| 12 | M. | 23.1 | 9.0 | 0.66 | 3.20 | 0.073 | 0.39 | ..... | ..... |
| 13 | M. | 26.1 | 12.4 | 0.90 | 2.22 | 0.69 | 0.47 | 120/90 | Neg. |
| 14 | M. | 22.4 | 6.9 | 0.59 | ..... | 0.082 | 0.31 | 120/90 | Neg. |
| 15 | M. | ..... | 9.2 | ..... | 3.00 | ..... | ..... | 122/90 | Neg. |
| | Fetus | ..... | 9.2 | ..... | ..... | ..... | ..... | ..... | ..... |
| 16 | M. | 53.0 | 24.8 | 1.40 | 5.86 | 0.11 | 0.47 | 140/90 | Neg. |
| | Fetus | ..... | 26.0 | ..... | 5.86 | ..... | ..... | ..... | Twins |
| 17 | M. | 27.0 | 11.5 | 1.30 | 2.41 | 0.091 | 0.43 | 138/85 | Trace Alb. |
| 18 | M. | 23.9 | 7.6 | 1.30 | 2.14 | 0.09 | 0.31 | 110/50 | Neg. |
| | Fetus | 24.0 | 7.6 | 1.30 | 2.20 | 0.095 | ..... | ..... | ..... |
| 19 | M. | 25.8 | 9.0 | 1.40 | 2.04 | 0.10 | 0.35 | Under 120–syst. | Neg. |
| | Fetus | 25.1 | 9.0 | 1.53 | 2.15 | 0.089 | ..... | ..... | ..... |
| 20 | M. | 26.0 | 10.3 | 2.00 | 1.80 | 0.09 | 0.40 | Under 120–syst. | Neg. |
| | Fetus | 26.0 | 10.3 | 1.90 | 1.65 | 0.09 | ..... | ..... | ..... |
| Ave. | M. | 29.4 | 11.9 | 1.21 | 2.85 | ..... | ..... | ..... | ..... |

*N. B. = No blood for analysis.

or during long labor. It has been established that muscular activity cannot increase the production of endogenous uric acid.

The high uric acid retention frequently found at the end of labor may account in part for the high uric acid content found by Kingsbury and Sedgwick[13] in the newborn; although in the newborn one must consider the additional uric acid derived from the nucleated red cells which suffer a rapid destruction soon after birth.

### TOXEMIA AND ECLAMPSIA TABLES V, VI AND VII

Both from the clinical course of the disease and from autopsy findings, we know that eclampsia and toxemia are always accompanied

TABLE V

ECLAMPSIA

BLOOD SPECIMENS ANTE- AND POSTPARTUM

| CASE | PERIOD | PARITY | CLINICAL NOTES | DATE EMPTYING UTERUS | DATE BLOOD SPECIMEN | BLOOD ANALYSIS | | | | URINE | | FOLLOW UP NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | ALBUMIN | CASTS | |
| 1 | 9 Mos. | P. | Admitted 7-8-18. For two weeks before admission, persistent headache, edema and vomiting. Admitted in labor and having convulsions; delivered same day, 7-8-18. B. P. on admission 155/115 B. P. on discharge 120/65. First blood taken intrapartum. | 7–8–18 | 7– 8–18<br>7– 9–18<br>7–12–18 | 44.00<br>50.50<br>21.00 | 17.30<br>23.10<br>11.50 | .....<br>5.40<br>3.80 | 5.00<br>7.20<br>6.60 | 2 + | Many | Seen 12-29-20. Mother in good condition. B. P. 120/70. Urine negative. Second confinement 7-19-20, perfectly normal. Both babies alive and well. |
| 2 | 7½ Mos. | M. | Admitted 8-2-19 in labor having developed severe headache and nausea 24 hours previously; followed by two convulsions at home. Version and breech extraction, live child. Thirteen convulsions after admission; last one, three days after delivery. Edema and headache for one month previous to admission. B. P. on admission 160/110; on discharge 120/80. | 8–3–19 | 8– 3–19<br>8– 5–19<br>9–15–19 | 35.30<br>35.00<br>45.50 | 15.70<br>14.40<br>..... | 3.10<br>3.10<br>0.97 | 5.10<br>5.00<br>..... | 4 + | Many | Seen 12-30-20. Highly nervous. B. P. 118/68. Urine negative. Induced abortion 1-19-20. Baby well. |
| 3 | 8 Mos. | M. | Admitted 11-27-18 with convulsions; temperature 103, with pulmonary signs. Labor induced; 12 convulsions; stillborn child 5½ hours later. Patient died twenty minutes later in coma. Temperature 104. B. P. 145/100 on admission, followed by 175/105. | 11–28–18 | 11–28–18 | 57.00 | 32.40 | 1.85 | 3.50 | 4 +<br>Solid | Many | Patient died 11-28-18. |
| 4 | 6 Mos. | P. | Admitted 2-17-19 having had headache, edema and visual disturbance for two weeks before admission. B. P. 175/105—2-19-19. Labor induced; 6-months' stillbirth 2-20-19, followed immediately by seven convulsions. Developed jaundice; bronchopneumonia. Died 2-25-19. B. P. on admission 145/100. | 2–20–19 | 2–18–19 | 51.70 | 25.20 | 1.10 | 4.00 | 2–17–19<br>4 +<br>2–25–19<br>Solid | Many<br><br>Many | Patient died 2-25-19. |

TABLE V—CONTINUED

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 8 Mos. | M. | Admitted 1-3-19. Was said to have had a convulsion before admission. Labor induced; delivered of a premature live child 1-5-19. Three convulsions intrapartum, none afterwards. Onset apparently sudden. B. P. on admission 174/108; 1-7-19, 160/100. | 1- 5-19 | 1- 4-19<br>1- 5-19<br>1-10-19<br>1-15-19<br><br>11-29-20 | 31.00<br>31.60<br>30.40<br>.....<br><br>34.00 | 10.80<br>10.90<br>10.60<br>.....<br><br>17.20 | 1.30<br>1.20<br>1.00<br>.....<br><br>0.96 | 4.80<br>4.80<br>3.40<br>3.05<br><br>1.76 | 1+ | Many | Seen 11-29-20; B. P., 128/70; urine negative Subsequent pregnancy perfectly normal in 1920. Premature child died. |
| 6 | 7½ Mos. | P. | Admitted 4-3-18. Sudden onset previous day with severe epigastric pain, edema and convulsions. 4-3-18 bag inserted, temperature 103, and pulmonary signs; bag removed 4-5-18, patient died undelivered. B. P. 205/120 before death. | Undelivered | 4- 3-18 | 43.5 | 19.45 | 0.98 | 1.58 | Solid | Many | Patient died 4-6-18. |
| 7 | 7½ Mos. | P. | Admitted 6-28-18. Convulsions and coma 6-29-18. Labor induced. Six convulsions intrapartum. Spontaneous delivery 7-1-18. B. P. on admission, 150/120; normal on discharge 7-11-18. | 7- 1-18 | 6-30-18<br><br>1-17-21 | 50.50<br><br>32.50 | 32.40<br><br>15.10 | 1.30<br><br>1.00 | 10.00<br><br>3.28 | 6-30-18<br>4+<br><br>7- 8-18<br>1.8% | Many<br><br><br>Few | Seen 12-30-20. Mother and baby well. B. P., 120/65 Urine negative. |
| | 8 Mos. | P. | Admitted 5-28-18 in coma, having had one convulsion; induced labor; spontaneous delivery; 5-hour labor. Two convulsions antepartum; three intrapartum; and seven postpartum; Since 4th month, has had headache and edema. B. P., 160/100 on admission. On discharge 6-13-18. B. P. normal; trace of albumin. | 5-29-18 | 5-30-18<br>6- 3-18<br>6- 7-18 | 51.20<br>44.10<br>41.10 | 25.20<br>21.00<br>21.40 | 2.88<br>2.00<br>1.79 | 6.76<br>5.60<br>2.50 | 5-28-18<br>1+<br><br>6- 4-18<br>Negative | Many<br><br>Few | Seen 12-30-20. Mother in good condition. Baby well. Second confinement July, 1920, normal. Both babies well. Urine negative. B. P. 120/80. |
| 9 | 7½ Mos. | P. | Admitted 3-11-18, having had a convulsion 12 hours previously. Labor immediately induced. Delivered of dead fetus in 9 hours. Nineteen convulsions between admission and delivery. Fourth day postpartum, developed a psychosis. Transferred to Insane Asylum. | 3-11-18 | 3-11-18<br>3-15-18 | 58.5<br>47.5 | 34.5<br>18.0 | 1.06<br>0.96 | 5.85<br>3.10 | 1+<br>2+ | 2+ | Recovered, but insane. |
| 10 | 7½ Mos. | P. | Admitted 6-25-18 in labor, having convulsions. For past month has had headache and swelling of ankles. Gives a history of having had a convulsion two weeks before admission. Spontaneous delivery live child. Died in 24 hours. B. P. 240/170. | 6-27-18 | 6-25-18<br>6-26-18 | 41.8<br>45.5<br>52.6 | 17.3<br>21.2<br>18.7 | 1.5<br>1.4<br>1.8 | 6.1<br>6.4<br>6.6 | 3+ | Many | Could not be traced in January, 1921. |

TABLE V.—Continued

ECLAMPSIA

BLOOD SPECIMENS ANTE- AND POSTPARTUM

| CASE | PERIOD | PARITY | CLINICAL NOTES | DATE EMPTYING UTERUS | DATE BLOOD SPECIMEN | BLOOD ANALYSIS | | | | URINE | | FOLLOW UP NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N. P. N. | UREA NITR. | CREATININ | URIC ACID | ALBUMIN | CASTS | |
| 11 | 9 Mos. | P. | Admitted 6-17-18 in labor, fully dilated and having had five convulsions before admission; breech extraction. Died 2½ hours later after four more convulsions. B. P. 180/100. | 6–17–18 | 6–17–18 | 39.6 | 20.5 | 3.5 | 8.3 | 1+ | Many | Patient died 6-17-18. |
| 12 | 9 Mos. | P. | Admitted 4-23-18 with convulsions and in labor; onset sudden; delivered 4-24-18 by forceps. Mother and baby discharged in good condition 5-13-18. B. P. on admission 150/115; on discharge 126/105. | 4–24–18 | 4–23–18<br>4–25–18<br>4–30–18 | 49.6<br>41.7<br>47.0 | 22.62<br>19.10<br>15.12 | 1.33<br>1.30<br>..... | 4.10<br>Trace<br>..... | 1+ | Many | Seen 1-7-21, urine normal; B. P. 120/78. 7-31-20, normal pregnancy. Both children well. |
| 13 | 8 Mos. | M. | Admitted 5-17-18 in coma, convulsions, and with marked edema. B. P. 190/110. Delivered by caesarean 5-18-18. 56 convulsions in hospital. | 5–18–18 | 5–17–18<br>5–29–18 | 40.00<br>51.00 | 14.40<br>24.5 | 0.95<br>0.91 | 7.40<br>2.45 | 4+ | 2+ | Recovered. Doctor reports mother and baby in good condition. |
| 14 | 9 Mos. | P. | Admitted 3-19-18, with convulsions and a history of having had visual disturbance and edema for two weeks. Bag inserted, delivered the same day of stillbirth; 4 convulsions. B. P. on admission 174/78; on discharge 128/86. | 3–19–18 | 3–19–18<br>3–21–18<br>3–25–18 | 52.1<br>52.2<br>39.0 | 25.56<br>24.90<br>15.1 | 1.21<br>1.23<br>0.95 | 6.13<br>5.0<br>2.84 | 4+ | Many | Seen 11-20-20. Patient in good condition; B. P. 130/70; urine negative. Fifteen months after leaving hospital had a caesarean section for placenta previa; live baby. No signs of toxemia in 2d preg. |
| 15 | 6 Mos. | P. | Admitted 5-18-19 in labor, having had one convulsion and giving a history of edema, headache, visual and gastric disturbances for previous six weeks. B. P. 156/90; four convulsions intrapartum. Patient discharged in good condition 5-31-19. | 5–19–19 | 5–19–19<br>5–23–19<br>6– 2–19<br>1– 5–21 | 62.50<br>36.90<br>37.40<br>33.00 | 23.70<br>18.7<br>18.7<br>15.90 | 1.00<br>0.86<br>1.30<br>0.96 | 9.14<br>1.90<br>2.00<br>2.92 | 4+ | Many | Seen 12-30-20. Another pregnancy terminated 6-19-20, full term, normal child. Had some edema and headache during this pregnancy. B. P. 135/90; urine shows trace of albumin; frequent headaches. |

TABLE V—CONTINUED

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 9 Mos. | M. Admitted 6-15-18 and delivered after a spontaneous labor 7-5-18 of normal child. Only four convulsions after delivery. Gives a history of epilepsy in childhood. In a previous pregnancy had convulsions. Has had frequent convulsions throughout this pregnancy and for last two days, convulsions have become almost constant. B. P. 144/98 on admission; on discharge 120/80, 7-16-18. | 7- 5-18 | 6-19-18<br>6-24-18<br><br><br>1- 7-21 | 38.20<br>29.60<br><br><br>29.01 | 21.60<br>11.50<br><br><br>13.8 | 1.43<br>1.32<br><br><br>0.96 | 7.10<br>6.80<br><br><br>1.72 | 1+ | Many | Seen 1-7-21. Patient had subsequent pregnancy ending 10-16-19; went to term but had convulsions throughout pregnancy; again showed increased B. P. and large amount of albumin. Labor induced; child died. Seen 1-5-21; evidently an epileptic with added toxemia during pregnancies. B. P., 115/65. Albumin—trace. Very bad teeth. |

TABLE VI

ECLAMPSIA

BLOOD SPECIMENS POSTPARTUM

| CASE | PERIOD | PARITY | CLINICAL NOTES | DATE EMPTYING UTERUS | DATE BLOOD SPECIMEN | BLOOD ANALYSIS | | | | URINE | | FOLLOW UP NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N. P. N. | UREA NITR. | CREAT-ININ | URIC ACID | ALBUMIN | CASTS | |
| 1 | 5 Mos. | P. | Admitted 6-8-18 having convulsions and in labor; immediately delivered. Headache, nervousness, and some edema for the two weeks preceding. B. P. 6-8-18, P. P. 125/80; on discharge 6-14-18, B. P., 112/60. | 6- 8-18 | 6-10-18 | 44.00 | 30.00 | 1.80 | 6.50 | 4+ | Many | Seen 12-20-20. Second confinement Nov., 1919. Normal birth; mother and baby well. B. P. 130/90; urine neg. |
| | | | | | 1- 5-21 | 29.90 | 14.50 | 1.00 | 2.13 | | | |
| 2 | 6½ Mos. | M. | Admitted 2-17-18 immediately after delivery, having convulsions, in a state of coma, and with suppression of urine. Died next day. B. P. 200/140. | 2-17-18 | 2-18-18 | 83.6 | 63.8 | 4.0 | 7.6 | 3+ | Many | Patient died 2-18-18. POST MORTEM FINDINGS Pyelonephritis with ureteritis, right; and cystitis. Acute parenchymatous degeneration of left kidney (with infarction). Acute hepatitis (with infarction). Lobular pneumonia (aspiration) with acute pulmonary congestion. Acute bronchitis. Acute hemorrhagic myocarditis. Acute aortitis. Acute splenitis. Accessory spleen. Puerperal uterus. Congestion of viscera. |
| 3 | 9 Mos. | P. | Admitted 3-9-18 having had a convulsion 15 minutes before. No edema, no dyspnea. B. P. 150/95. Three convulsions in next two hours. Delivered by abdominal cesarean. Living child. Three convulsions in next 12 hours. No further convulsions. Normal B. P. 122/80 on discharge. | 3- 9-18 | 3-13-18 | 29.2 | 10.8 | 0.99 | 2.5 | 1+ | Few | Mother and child well in 1921. |

TABLE VI—CONTINUED

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 9 Mos. | P. | Admitted 7-30-18. Headache and edema for previous two weeks. On July 30, delivered normally of twins. Four hours later, convulsions began; seven in next 24 hours. B. P. 140/95; on discharge 8-5-18, 120/80. | 7–30–18 | 7–31–18<br>8– 1–18<br>8– 7–18 | .....<br>.....<br>34.0 | 24.6<br>23.8<br>19.4 | .....<br>.....<br>1.5 | 12.9<br>9.5<br>2.0 | 7–31–18<br>Boiled Solid.<br>8–3–18<br>1+<br>8–5–18<br>1+ | Many<br><br>Few<br><br>None | Seen 12-3-20. One twin died when six weeks old. Second confinement June 1920. Mother and children well. |
| 5 | 9 Mos. | P. | Admitted 9-1-19 in labor, while being delivered had a convulsion, followed by semicoma. Delivered normally of a live child. Had six convulsions during the day. B. P. on admission 156/90; on discharge 128/86. | 9– 1–19 | 9– 3–19 | 28.00 | 12.20 | 0.74 | 1.30 | 1+ | None | Seen 12-18-20. Baby well. Patient four months' pregnant. Well. |
| 6 | 9 Mos. | P. | Admitted 9-3-18. For past three days, headache, edema, and disturbed vision. Admitted with cervix fully dilated and marked edema. Severe eclamptic convulsion; no recurrence. Had severe postpartum hemorrhage. Delivered of full term live child. B. P. on admission 150/110; on discharge 122/90. | 9– 3–18 | 9– 4–18 | 34.6 | 13.6 | 2.4 | 3.0 | 9– 4–18<br>2+<br>9–5–18<br>2+<br>9–7–18<br>1+ | Few<br><br>Few<br><br>None | Seen 12-30-20. Baby well. Mother at Sea View Hospital; tuberculosis. |
| 7 | 9 Mos. | M. | Admitted 8-17-19 having been normally delivered at home 8-15-19 and having developed convulsions 30 hours after delivery. 12 convulsions in hospital. Gave history of headache and edema for six weeks prior to delivery. B. P. on admission, 172/120; on discharge 122/80. | 8–15–19 | 8–20–19<br><br>1– 3–21 | 47.70<br><br>33.90 | 22.80<br><br>16.50 | 1.45<br><br>1.10 | 4.7<br><br>3.21 | On adm.<br>4+<br><br>On dis.<br>1+ | Many<br><br>Few | Seen 11-20-20. No subsequent pregnancy. Baby well. Mother suffers from severe headaches. B. P. 122/80. Urine neg. Seen 1-10-21. Still has headaches. B. P. 118/70. Urine neg. |
| 8 | 9 Mos. | M. | Admitted 3-1-18. In latter half of pregnancy complained of severe frontal headache, swelling of face and legs, and visual disturbances. Normal labor, stillbirth, 2-19-18. Convulsions suddenly 3-1-18; 32 convulsions in next 24 hours. B. P. on admission 156/98; on discharge 120/80. | 2–19–18 | 3– 1–18<br>3– 7–18 | 30.3<br>48.2 | 15.75<br>16.9 | 1.10<br>1.30 | 3.16<br>..... | 2+ | Few | Discharged 3-15-18 in good condition. Seen 1-7-21. Had full term child; labor and puerperium normal. |
| 9 | 8½ Mos. | M. | Admitted 4-3-19 in labor. Delivered normally of a live child the same day. Headache throughout pregnancy, become severe with edema and epigastric pain 3-31-19. Had two convulsions before admission; four after. B. P. on admission, 190/100; on discharge 146/90. | 4– 3–19 | 4– 7–19<br>4–14–19 | 37.40<br>36.00 | 15.10<br>13.90 | 1.40<br>0.80 | 3.40<br>4.90 | 4+ | ..... | Seen 1-8-21. Mother and baby in good condition. Normal B. P. and urine. Refused to have blood taken. |

TABLE VI.—Continued

ECLAMPSIA

BLOOD SPECIMENS POSTPARTUM

| CASE | PERIOD | PARITY | CLINICAL NOTES | DATE EMPTYING UTERUS | DATE BLOOD SPECIMEN | BLOOD ANALYSIS | | | | URINE | | FOLLOW UP NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N. P. N. | UREA NITR. | CREATININ | URIC ACID | ALBUMIN | CASTS | |
| 10 | 9 Mos. | M. | Admitted 6-28-18. Delivered 7-2-18 of a live child, having no symptoms of toxemia of pregnancy at this time. Three days later, suddenly developed convulsions, marked edema, followed by pulmonary edema and death. (10 convulsions.) B. P. on admission 128/85; 7-5-18, 160/120. Marked trace albumin on admission. | 7- 2-18 | 7- 5-18 | 42.50 | 18.70 | 4.20 | 11.30 | 4+ | Many | Patient died 7-6-18. |
| 11 | ..... | P. | Admitted 2-2-18 in convulsions. Bag inserted; delivered in 4 hours by version. B. P. 158/120. Developed multiple abscesses and transferred to surgical side on 2-16-18. Discharged A. O. R., 3-18-18. | 2- 2-18 | 2- 4-18<br>2- 6-18<br>2-13-18<br>2-18-18<br>2-25-18 | 51.04<br>42.2<br>30.2<br>37 5<br>40.5 | 15.9<br>17.9<br>18.7<br>16.0<br>13.6 | .....<br>1.8<br>1.83<br>1.6<br>0.73 | 5.25<br>7.92<br>1.43<br>.....<br>1.14 | 3+ | Many | Left the hospital at her own request 3-18-18. Died at home, probably from septicemia. Baby died in the hospital from hemophilia. |

by pathologic changes in the liver as well as in the kidney. The effect of the liver in altering the nitrogen partitions of the blood and urine is still imperfectly understood. Stadie and Van Slyke,[14] having recently had the opportunity to study intensively the metabolism in a case of acute yellow atrophy of the liver, found that despite the almost total destruction of the liver a large proportion of the urea was still formed. This seems to show that there is an efficient extrahepatic function in the formation of urea as was deduced by Folin and Denis.[15] Moreover, Stadie and Van Slyke found no significant reduction in the alkali reserve of the blood; but they found an increase of aminonitrogen in the blood and urine above what could be accounted for by the rapid autolysis of the liver, thus strengthening the conception of the deamination function of the liver. We hope that our knowledge of hepatic function in terms of blood chemistry may in time so advance that we shall be able to read in the blood pictures of eclampsia, the hepatic as well as the renal disturbances.

An attempt to differentiate hepatic and renal toxemias on the basis of the nitrogen partition in the blood is not safe. To interpret a high undetermined nitrogen fraction (indicated by a low ratio of urea N. to N.P.N.) as a failure in deaminization on the part of the liver, is not justified. In our tables of normal pregnancy the ratio of urea N. to N.P.N. ranges from 12 to 59 per cent. This would imply a marked variation in the undetermined fraction even in uncomplicated pregnancy. And, again, in our eclamptic series a fatal case, demonstrating on autopsy the liver pathology of eclampsia, shows a ratio of urea N. to N.P.N., of 76 per cent, the highest of our whole series, indicating probably the lowest undetermined nitrogen fraction in the series. Foster[16] found in the study of uremia with convulsive symptoms a high undetermined nitrogen fraction (20 per cent) and for these cases there has been, as yet, no suggestion of a disturbed hepatic function.

The blood pictures resulting from renal lesions, however, have a clearer meaning to us. The kidney as a filter, the threshold of permeability for the several nitrogenous waste products, and the significance of the retention of these several partitions, have all been studied to advantage.

Analysis of the change in the blood content, both relative and absolute, of the several nitrogen waste products, has led to the belief that uric acid is the most difficult to eliminate and creatinine the easiest. Therefore with renal insufficiency the blood first discloses a uric acid retention and lastly a creatinine accumulation. Myers and Lough[17] have long maintained that a blood creatinine of 5 mg. or more per hundred c.c. warrants a grave prognosis. This thesis has been more recently strengthened in a study of a large series of cases by Myers and Kilian.[18] Myers and Fine[19] have confirmed the prevailing conceptions of kidney filtration by demonstrating an early lowering of the

TABLE VII

TOXEMIA OF PREGNANCY

(WITHOUT CONVULSIONS)

| CASE | PERIOD | PARITY | CLINICAL NOTES | DATE EMPTYING UTERUS | DATE BLOOD SPECIMEN | BLOOD ANALYSIS | | | | URINE | | FOLLOW UP NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N. P. N. | UREA NITR. | CREATININ | URIC ACID | ALBUMIN | CASTS | |
| 1 | 5 Mos. | M. | Admitted 5-14-18 in coma. No history obtained, except that she had had headache for several weeks. No convulsions. B. P. 135/115. Died within a short time after coming into the hospital. | 5–14–18 | 5–14–18 | ..... | 40.1 | ..... | 7.80 | 1+ | Few | Patient died 5-14-18. |
| 2 | 7 Mos. | P. | Admitted 2-22-18. Labor induced. Spontaneous labor; stillbirth. Headache, vomiting, and disturbed vision for two weeks before admission. B. P. 175/130. | 2–22–18 | 2–25–18 | 40.5 | 15.5 | 1.05 | 1.65 | 4+ | 2+ | Discharged from hospital improved, but could not be traced in 1920. |
| 3 | 7 Mos. | M. | Admitted 5-27-18 with a history of headache, edema and dyspnea for more than two weeks before admission. B. P., 180; heart enlarged and with mitral regurgitation. Discharged 7-6-18. | 6– 2–18 | 5–31–18<br>6– 3–18<br>6–16–18<br>6–19–18 | 53.3<br>36.7<br>44.0<br>..... | 31.7<br>19.5<br>21.6<br>15.9 | 3.1<br>1.63<br>1.73<br>2.40 | 4.78<br>4.30<br>8.90<br>7.70 | 4+ | 2+ | Seen Jan. 29-21. Cancer of breast; operated in 1918. Mitral regurgitation. B. P., 180/100; urine + + +; casts. Edema and headache. |
| 4 | 7 Mos. | M. | Admitted 3-25-18, complaining of vomiting and edema for the past six months. B. P. 200/160. Not improving; labor induced, resulting in a stillbirth 4-25-18. B. P. on discharge, 150/100. | 4–25–18 | 4– 3–18<br>4–23–18<br>4–30–18 | 39.6<br>39.7<br>39.6 | 15.5<br>17.3<br>7.2 | 1.08<br>0.98<br>1.07 | 8.0<br>3.9<br>2.13 | Boiled<br>Solid | Few | Seen 1-20-21. Confined at Sloane May 1920; normal pregnancy; normal spontaneous labor. During pregnancy B. P. ranged from 104 to 110 systolic. Urine negative throughout antepartum period. |
| 5 | 8 Mos. | M. | Admitted 7-20-18. Gave a history of having had edema, headache and disturbed vision, and vomiting for two months before admission, greatly aggravated during past week. B. P. 200/160. Labor induced 7-21-18; delivered of live child which died in short time. Patient discharged 8-1-18. | 7–21–18 | 7–23–18<br>7–31–18<br>9–15–19<br>9–22–19<br>1–25–21 | .....<br>43.3<br>35.4<br>41.8<br>58.40 | 16.5<br>16.5<br>22.00<br>18.70<br>25.80 | 3.1<br>2.0<br>0.85<br>0.56<br>1.88 | 7.8<br>4.0<br>3.06<br>1.91<br>2.55 | 7–20–18<br>Boiled<br>Solid | Many | Seen 1-25-21. Induced labor at 7½ months in October, 1920. B. P., 210/120. Urine: large number. Headache and edema. |

TABLE VII—CONTINUED

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 8 Mos. | P. | Admitted 6-9-18 in coma. No history obtainable. Marked edema of legs and face. Bag inserted. Delivered macerated 8-months' fetus. B. P. 160/90. | 6–10–18 | 6– 9–<br>6–11–18<br>18 | 106.0<br>116.0 | 80.0<br>86.0 | 6.50<br>6.60 | 8.70<br>9.10 | | Many | Patient died. |
| 7 | 9 Mos. | P. | Admitted 6-1-18 in coma with stertorous breathing. No edema. Only history obtainable, one of sudden onset day before admission, with severe headache, vomiting and epigastric pain. Labor induced immediately. Patient died the same day. B. P., 230/150. | 6– 1–18 | 6– 1–18 | 63.0 | 34.6 | 4.8 | 8.0 | ..... | Many | Mother and child died 6-1-18. |

renal permeability to uric acid, a later lowering to urea and lastly to creatinine. The retention of the nitrogen waste products in the blood of eclampsia and toxemia is very much lower than that found in uremia. The figures are also lower than those found in acute nephritis The blood pictures do not correspond with any of the usual nephritic pictures but come closer to those found in the so-called "parenchymatous" nephritis. The findings in toxemia and eclampsia of investigators already quoted are in accord with ours.

In the 34 cases of eclampsia and toxemia of pregnancy included in the tables, there are 26 typical eclampsias; three others were admitted in coma without convulsions and were clinically considered uremics; four cases were considered preeclamptic; and one was an epileptic with added toxemia during pregnancy.

It is necessary in studying individual blood pictures of these conditions to remember that we are dealing with an acute and violent disturbance which tends rapidly to subside or to end in death; and also that the blood picture changes as rapidly, following the clinical course. In order to define, therefore, the significance of a blood picture it is necessary to know the time relation between the taking of the blood and the onset of symptoms or of labor. The importance of this is illustrated in several of our cases where the blood was taken after convalescence was established and in which we find nearly normal blood pictures.

The average blood picture for these 34 cases is as follows:

| N.P.N. | UREA N. | CREATININ | URIC ACID | U.N. TO N.P.N. |
|---|---|---|---|---|
| 49.7 | 26. | 2.17 | 6.19 | 52 per cent |

The average ratio of urea N. to the total N.P.N. for the entire series is as shown, 52 per cent. The highest ratio that we find is 76 per cent and the lowest is 33 per cent. In the case with a ratio of 76 per cent there was marked kidney insufficiency, as evidenced by the complete suppression of the urine. In this case the autopsy findings, besides showing kidney involvement, showed the changes in the liver typical of eclampsia.

In this series we find that in every case where there was high retention of all the blood constituents, indicating a marked kidney insufficiency, the patient died. In some cases the kidneys are but slightly involved, as shown by the fact that the blood taken two days postpartum gave practically a normal blood picture.

Again, the significance of a high creatinine retention in denoting kidney insufficiency is well shown by our tables. Frequently it accompanies high retentions in other nitrogenous waste products, but occasionally the creatinine and the uric acid are the only constituents that are definitely raised in the blood picture. Out of 9 cases showing creatinine above 3 mg. as many as 5 died; and two afterwards developed into chronic nephritics. The remaining two, when seen thirty

months later, had had normal pregnancies and showed no signs of nephritis. Altogether there are nine deaths in this entire series and the creatinine was found to be high in five of them. In one of the other four cases the creatinine is not given; but from the marked urea retention we may infer a probably high creatinine. Two others of the nine show normal creatinine; but the bloods were taken from three to seven days before death. The remaining one, who died the same day the blood was taken, entered the hospital at the height of the influenza epidemic with a typical eclamptic seizure, but also having a temperature of 103° and with pulmonary involvement. It is possible that the eclampsia in this case was a complication of influenza. The blood creatinine may therefore be regarded as of value in estimating the degree of renal insufficiency; and its elevation above 3 mg. would justify a guarded prognosis both for the immediate future and for subsequent pregnancies.

In the entire series, both in the preeclamptic condition and in eclampsia, we find a high retention of uric acid. In some cases it is the only nitrogen waste product which is very much raised. In another extensive series of cases, which we are not including in this report, since the examinations were made in another laboratory, we also have found a uniform increase in uric acid in preeclamptic conditions before labor. In none of the cases that recovered have we found the patient showing any symptoms of nephritis where the uric acid returned to normal early in convalescence. On the other hand, where the uric acid remains high throughout the obstetrical period, especially if there has been a high creatinine retention, we find, according to the "follow-up" notes about thirty months later, that the patient is a chronic nephritic.

A question with which an obstetrician after taking care of a case of eclampsia, is invariably confronted, is whether this woman can safely go through another pregnancy, or whether future pregnancies will again endanger her life. Clinically, we depend for an answer upon the rapidity with which albuminuria clears up and the blood pressure returns to normal. If the kidneys have not been seriously injured, we can say that the patient will probably not have eclampsia again. The blood pictures, added to the clinical findings, are of great value in making this prognosis.

Of the 34 cases here reported we find that nine died in the hospital and one from an infection a short time after leaving the hospital. Twenty-two of the remaining 24 cases were seen during December, 1920, and January, 1921, that is, about 30 months after their eclamptic seizures. Among these we find only two definite nephritics. In looking at the blood pictures of these two cases, we find that the uric acid remained especially high throughout the obstetrical period; that the other waste products also failed to return to normal; and that in both cases the creatinine was more than 3 mg.

According to the follow-up reports, ten women have had perfectly normal subsequent pregnancies and labor. In each of these ten cases the blood picture shows a slight retention of all the waste products with a rapid return to normal, indicating only slight kidney insufficiency. In such cases, therefore, one is justified in giving a hopeful prognosis for subsequent pregnancies.

The histories in this entire series of eclampsias emphasize the great importance of prenatal care. For in the majority of cases there were premonitory warnings, sometimes a few days, sometimes several weeks, before the eclamptic seizures developed.

The blood pictures in preeclamptic conditions, since they indicate the extent of kidney insufficiency, are of value both in prognosis and in outlining the treatment.

## SUMMARY AND CONCLUSIONS

I. In normal pregnancy, as compared with the nonpregnant state, we find a low total of nonprotein nitrogen, low urea nitrogen and a very low ratio of urea nitrogen to the total nonprotein nitrogen.

II. The excretory nitrogenous constituents in the maternal and the fetal circulations at the end of labor are practically identical.

III. A definite retention of uric acid in the blood at the end of labor is found only in abnormal cases.

IV. The blood pictures in eclampsia and toxemia of pregnancy are interpreted most readily in terms of kidney insufficiency.

V. The significance of a given blood picture can be defined only in the light of the clinical conditions at the exact time when the blood was taken.

VI. Marked kidney insufficiency, indicated by high retention of nitrogenous waste products, warrants a very grave prognosis.

VII. High creatinine retention seems to warrant a serious prognosis.

VIII. When the nitrogenous constituents do not return to normal early in convalescence, a doubtful prognosis for subsequent pregnancies is justified.

IX. A rapid return of the blood picture to normal justifies a favorable prognosis for subsequent pregnancies.

## REFERENCES

(1) Jour. Am. Med. Assn., Oct. 13, 1917. (2) Am. Jour. Obst., 1914, lxx, 614. (3) Bull. Johns Hopkins Hosp., 1916, xxvii, 343. (4) Jour. Biol. Chem., 1917, xxii, 63. (5) Bull. Lying-in Hosp., New York, March, 1920. (6) Bull. Johns Hopkins Hosp., 1917, xxviii, 199. (7) Am. Jour. Med. Sc., 1917, cliii, 194. (8) Arch. Int. Med., 1913, xii, 288. (9) Bull. Johns Hopkins Hosp., 1916, xxvii, 121. (10) Bull. Johns Hopkins Hosp., 1917, xxviii, 137. (11) Compt. rend. Soc. de Biol., 1914, lxvi, No. 1, p. 457. (12) Lyon Medical, 1913, cxxi, 1126. (13) Jour. Biol. Chem., 1917, xxxi, 261. (14) Arch. Int. Med., 1920, xxv, 693. (15) Jour. Biol. Chem., 1912, xii, 141. (16) Jour. Am. Med. Assn., 1916, lxvii, 927. (17) Arch. Int. Med., 1915, xvi, 536. (18) Am. Jour. Med. Sc., 1919, clvii, 674. (19) Arch. Int. Med., 1916, xvii, 570.

58 WEST FIFTY-FIFTH STREET.

(*For discussion see page* 94.)

# A STUDY OF THE OSSIFICATION CENTERS OF THE WRIST, KNEE AND ANKLE AT BIRTH, WITH PARTICULAR REFERENCE TO THE PHYSICAL DEVELOPMENT AND MATURITY OF THE NEWBORN

By Fred L. Adair, M.D., F.A.C.S., and Richard E. Scammon, Ph.D.
*From the Swedish Hospital of Minneapolis and the Departments of Obstetrics and of Anatomy of the University of Minnesota.*

ALTHOUGH numerous studies have been made of the prenatal and postnatal course of the ossification of the extremities, systematic observations on the occurrence of ossification centers in the joints at birth are limited to the roentgenographic studies of Pozier (1912) and Hasselwander (1909) and certain earlier medicolegal work. Pozier's study, while based on a large series of cases, was confined to an examination of the ossification of the knee joint in the newborn. Hasselwander studied the ankle only. Students of legal medicine who have investigated this problem have generally limited themselves to the study of the inferior femoral epiphysis, although Corrado (1891) and Toldt (1882) studied both the knee and the ankle centers by section at autopsy. Aside from a series of 10 cases examined by Puyhaubert (1913) no systematic study has been made of ossification of the carpus at birth.

The present study was undertaken with the object of determining the condition of the ossification centers of the wrist, knee and ankle in the newborn, their interrelationships, and particularly their relation to the maturity and to the size of the child. Incidentally we have considered the effect of parity and sex upon the condition of these centers at birth.

Our material consisted of 100 newborn children (45 females and 55 males) taken *seriatim* from the service of the senior author in the Maternity Ward of the Swedish Hospital of Minneapolis. Each of these children was weighed and was measured for total length, and radiographs were made of the ankles, knees and wrists of both sides within 48 hours after birth. The menstrual history of each case was also determined with care, and may be regarded as quite reliable since the mothers were all patients of the better class and of considerable intelligence.*

*We wish to express our appreciation of the liberality and interest of the Superintendent, G. W. Olson, and the Board of the Swedish Hospital for their support of this study and to acknowledge the cooperation of the supervising nurse, Miss Huseby, and of the radiologist, Miss Anna Johnson.

Of the 100 children studied, 45 were females and 55 were males. The average weight of the entire group was 3374 grams. The females ranged from 2185 to 4440 grams in weight, the average being 3367 grams. The males averaged 3380 grams in weight, the minimum being 2080 grams and the maximum 5060 grams. The average length of the females was 50 cm., the minimum 43 cm. and the maximum 54 cm. The average length of the males was 50.5 cm., the minimum 42 cm. and the maximum 55 cm. The average period of gestation, as calculated from the first day of the last menstruation, was 280 days. The minimum was 233 days and the maximum was 312 days. Of these cases two males and two females were frankly premature as evidenced both

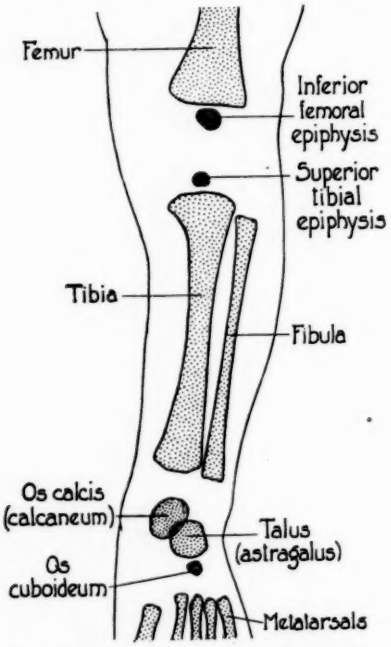


Fig. 1.—Tracing of a radiogram of the right leg of a full-term newborn child showing the various ossific masses. The epiphyses and the os cuboideum are indicated in heavy stipple in this and the following figures of the lower extremity.

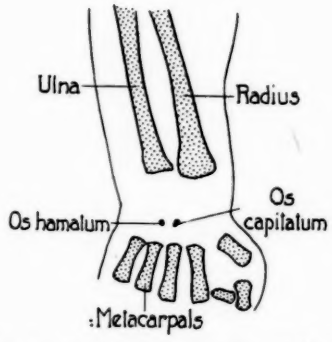


Fig. 2.—Tracing of a radiogram of the right hand of a full-term newborn child showing the various ossific masses.

by the weight and length and by the menstrual history. The body lengths and weights of three of the male infants distinctly indicated postmaturity although the menstrual history did so in one instance only. Of the hundred children, 64 were firstborn. There were no multiple births in the series.

The ossification centers under consideration will be taken up in the following order; knee, ankle and wrist. Figures 1 and 2 are tracings of radiographs of these regions in the newborn and the various ossific masses which they show have been labeled in accordance with the nomenclature employed in our descriptions.

THE CENTERS OF OSSIFICATION OF THE KNEE

*The Inferior Femoral Epiphysis.*—This center was present in 98 per cent of our cases, being absent only twice (in one female and in one male, both of which were frankly premature).

The course of ossification of the inferior extremity of the femur is probably better known than that of any other part of the skeleton. Early in the nineteenth century (1819) Beclard pointed out the significance of this center as a test of the maturity of the newborn. This lead to a series of extended studies of the subject by investigators in legal medicine, among the more important being those of Mildner (1850), Böhm (1858), Pleissner (1861), Casper (1862), Hartmann (1869), Barkow (1872), Toldt (1882), Corrado (1891), Tammasia

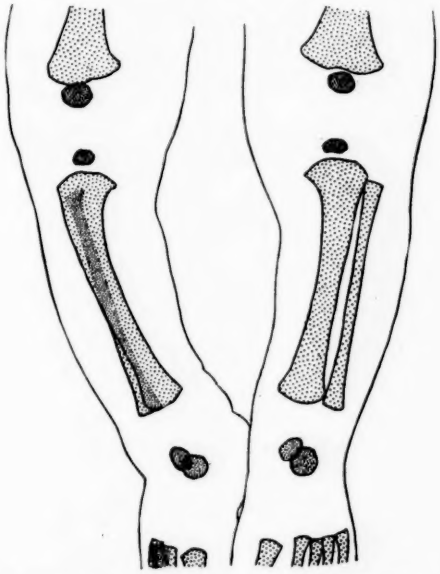

Fig. 3.—Tracing of a radiogram of the lower extremities of a male newborn of 289 days' gestation, having a birth weight of 3350 grams and a total length of 51.5 cm. Large knee centers but no cuboid centers.

(1893), and Guichard (1905) all of whom studied the center by section at autopsy. The only extensive radiographic study of the knee of the newborn is that of Pozier (1912) who examined 212 cases. A comprehensive survey of the literature on the subject would probably enable one to bring together records of the development of this center in over 2000 cases in late fetal life and early infancy. From the literature available to us we have collated the records of over 1600 cases and these, together with our series (making a total of 1717 observations), are shown in Table I and are illustrated graphically by the solid line curve in Fig. 26.

TABLE I*

FREQUENCY OF THE OSSIFICATION OF THE INFERIOR FEMORAL EPIPHYSIS IN LATER FETAL LIFE AND IN EARLY INFANCY

| AGE | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING A CENTER OF OSSIFICATION | PER CENT OF CASES SHOWING A CENTER OF OSSIFICATION |
|---|---|---|---|
| Seventh fetal month | 29 | 0 | 0.0 |
| Eighth fetal month | 143 | 7 | 4.9 |
| Ninth fetal month | 181 | 58 | 32.0 |
| Tenth fetal month | 271 | 228 | 84.1 |
| Birth and first week | 1004 | 995 | 95.1 |
| Second week | 42 | 41 | 97.6 |
| Third and fourth weeks | 70 | 69 | 98.6 |
| Second and third months | 27 | 27 | 100.0 |

*In tables I, II and III the specimens have been classified on the basis of the original observer's estimate of age or, when this was lacking, on the basis of total body-length interpreted by Hasse's rule.

These data indicate that the appearance of this center prior to seven fetal (lunar) months is extremely exceptional. However, the center may be found in the eighth fetal month, as our data indicate

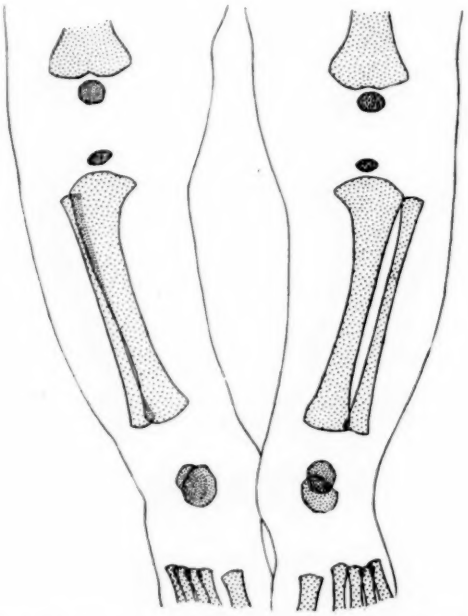

Fig. 4.—Tracing of a radiogram of the lower extremities of a female newborn of 280 days' gestation, having a birth weight of 4440 grams and a total length of 52 cm. Specimen of unusually large dimensions and with large knee centers but no cuboid ossification.

that it is present in approximately 1 case in 20. In the ninth fetal month the frequency of its occurrence rises rapidly, the average for the period being 32 per cent or about 1 case in 3. By the close of the ninth month the center is present in 60 per cent of all cases. This rapid ossification continues through the greater part of the tenth month, the average frequency for this period being 84.1 per cent, or

about 6 cases in 7. In the full-term newborn the data indicate that the center is present in about 19 cases in 20. The remaining moiety of the cases ossify rather slowly in the first postnatal month. This may indicate a small group of individuals tending to some perversion of bone development such as fetal rachitis.

On the whole these figures demonstrate that the ossification of the inferior femoral epiphysis is somewhat more precocious than the statements of a number of recent authors would indicate. Since the curve based on the combined data shows that this center is present in fully 50 per cent of all cases in the thirty-sixth week, it is evident that the value of this center as positive evidence of maturity is limited, although as it is usually absent prior to the twenty-eighth week, its presence may be taken as a practically certain indication of viability.

*The Superior Tibial Epiphysis.*—A definite ossific mass was present in the superior extremity of the tibia in 81 per cent, or slightly more than four-fifths of our series.

TABLE II

FREQUENCY OF THE OSSIFICATION OF THE SUPERIOR TIBIAL EPIPHYSIS IN LATER FETAL LIFE AND AT BIRTH

| AGE | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING A CENTER OF OSSIFICATION | PER CENT OF CASES SHOWING A CENTER OF OSSIFICATION |
|---|---|---|---|
| Seventh fetal month | 17 | 0 | 0.0 |
| Eighth fetal month | 34 | 0 | 0.0 |
| Ninth fetal month | 51 | 3 | 5.9 |
| Tenth fetal month | 213 | 88 | 41.3 |
| Birth | 253 | 195 | 77.1 |

The ossification of the superior epiphysis of the tibia has not been the subject of as much investigation as has the inferior femoral. The three main sets of observations on this point of ossification are those of Toldt (1882), Corrado (1891) and Pozier (1912), although Kjölseth (1913) has also reported a few observations. These records, together with our own data (making a total of 568 cases), are summarized in Table II and are shown in graphic form by broken line curve in Fig. 26.

The superior tibial epiphysis appears distinctly later than the inferior femoral. It is apparently always absent in the seventh and eighth months, although one instance of its occurrence in a female fetus of 40 cm. has been reported by Hassenstein (1892). In the ninth month its average frequency for the entire period is approximately 6 per cent, or about 1 case in 17, and according to our graph it is present in about 15 per cent at the end of this time. In the tenth month ossification proceeds very rapidly, the average frequency for the period being slightly above 40 per cent, or about 2 cases in 5. In full-term newborn children this center is present in 75 to 80 per cent of all cases.

Although definite statements regarding the time of appearance of this center are generally lacking even in more recent publications, it is evident from the study of the data presented in the literature and from our own observations that this point of ossification is a better test of maturity than is the inferior femoral epiphysis. The presence

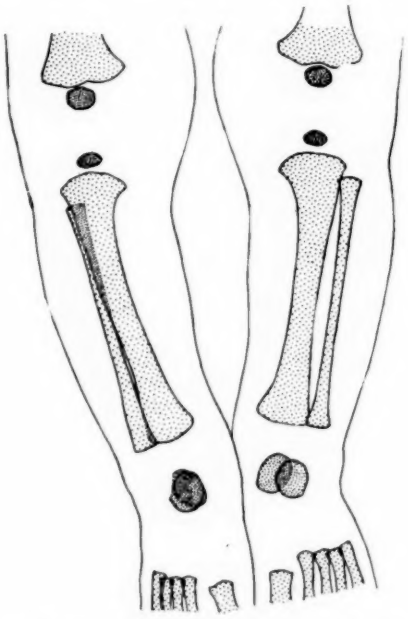

Fig. 5.—Tracing of a radiogram of the lower extremities of a female newborn of 287 days' gestation, having a birth weight of 3390 grams and a total length of 53 cm. Specimen of large dimensions and with large knee centers but no ossification of the cuboid.

of this center indicates in 5 cases out of 6 that the child has passed the ninth fetal month. The lack of this center, however, does not necessarily indicate prematurity as it is absent in nearly a fourth of full-term children at birth.

TABLE III

FREQUENCY OF THE OSSIFICATION OF THE CUBOID IN LATER FETAL LIFE AND AT BIRTH

| AGE | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING A CENTER OF OSSIFICATION | PER CENT OF CASES SHOWING A CENTER OF OSSIFICATION |
|---|---|---|---|
| Seventh fetal month | 17 | 0 | 0 |
| Eighth fetal month | 34 | 0 | 0 |
| Ninth fetal month | 45 | 2 | 4.4 |
| Tenth fetal month | 84 | 23 | 27.4 |
| Birth | 127 | 77 | 60.6 |

## THE BONES OF THE ANKLE

*The Astragulus (Talus) and Calcaneus.*—The calcaneus is the first bone of the ankle to ossify, making its appearance about the fifth

fetal month, and the astragulus undergoes ossification soon thereafter. As these bones were present in all of our cases, as well as in all similar cases reported by others, they require no further discussion.

*The Cuboid.*—The ossification of the os cuboideum was indicated in 38 per cent of the cases of our series.

The development of the cuboid has been studied by Toldt (1832), Corrado (1891), and Hasselwander (1909) who examined an aggregate of 256 cases. Kjölseth (1913) also studied a small series of cases but her results are published in such form that we cannot include them in our tabulations. The summary of all cases, including our series—a total of 356 cases—is given in Table III and is illustrated by the curve in dotted line in Fig. 26.

Ossification begins in the cuboid, as in the superior tibial epiphysis, in the first part of the ninth fetal month, but proceeds more slowly. The average frequency for the month is 4 per cent, or 1 case in 25. At the end of the ninth month it is present in approximately 12 per cent of all cases, or about 1 case in 8. Like the superior tibial, the frequency of the cuboid center of ossification rises very rapidly in the last fetal month, the average for the period being 26 per cent. In the full-term newborn child the center is present in 60 per cent, or three-fifths of all cases. Thus the significance of the ossification of the cuboid as a test of maturity at birth is about the same as that of the superior tibial epiphysis. Its presence indicates a little more definitely that the child has passed the ninth fetal month but since it is not found in 40 per cent of full-term newborn children its absence cannot be regarded as significant of prematurity.

## THE OSSIFICATION OF THE WRIST

The wrist is generally described as cartilaginous at the time of birth although no extensive studies have been made on the condition of the carpus in the newborn. Two bones of the carpus may be present at this time, the os capitatum (magnum) and the os hamatum (unciform). The older writers, who depended on autopsy specimens for their information, Rambaut et Renaut (1864), Béclard (1819), Sappey (1889), Debierre (1889) and others, generally described the os capitatum and os hamatum as appearing between the first and third years, although Meckel (quoted by Puyhaubert 1913) found it present at birth. Students employing radiography, on the other hand, usually report these bones as appearing somewhat earlier. Pryor (1908), whose work on the ossification of the hand is perhaps the most careful and extensive study to date, found that the os capitatum and os hamatum appeared between the third and sixth postnatal months in females and between the fifth and tenth postnatal months in males. Hess (1917) states that these centers may be seen only very rarely at the time of birth. Puyhaubert (1913) examined the

wrists of 10 newborn children and found that the capitatum and the hamatum were present in 2 cases. He concluded that the usual time of the ossification of the hamatum was during the first year and of the capitatum from the last fetal month to the close of the first year of extrauterine life. We found some evidences of ossification in the wrist in 15 instances of the series of 100. This indicates that Puyhaubert's figures are a little high, probably through chance in working with such a small series. The os capitatum alone was present in 7 instances, or nearly one-half of the cases showing carpal ossification. In most of the instances in which both points of ossification were present the os capitatum was apparently the larger, although this was not always true. In no case did we find the os hamatum alone present. There has been considerable difference of opinion as to which of these centers is the first to appear. Brice (in Quain 1915) and Nomballais (1909) state that the hamatum is the first to appear. Fuginami (1911) and Rotch (1909) recognize no distinction in the time of appearance of the two centers and Pryor (1908) and Puyhaubert (1913), who have done the most recent work on the subject, regard the capitatum as the first to ossify. Our observations indicate that the last view is the correct one, although the difference in the time of the inauguration of ossification in the two bones cannot be very great.

### RELATION BETWEEN OSSIFICATION AND BODY-LENGTH

The relation in our material between body-length and ossification is shown in Table IV. In studying this relation the cases were arranged according to total body-length in 4 classes of which the first 3 were each of 4 centimeters range and the last included all cases of 52 cm. or more.

The inferior femoral center was present in one-half of the cases falling between 40 and 44 cm. and in all cases above 44 cm.

The superior tibial center is closely correlated with body-length. It was present in one-quarter of the cases under 44 cm. and in nearly one-half of the cases between 44 and 48 cm. It was found in approximately five-sixths of all cases of 48 cm. and over, which may be regarded as a mature birth-length.

A peculiar and no doubt accidental condition was found in the relation of the ossification of the os cuboideum to the body-length. The center was present in one-half of the 4 cases having a length of less than 44 cm. and only 22 per cent of those of 44 to 48 cm. But with this exception it occurs in a progressively higher percentage with increasing body-length. It was present in about two-fifths of all children of 48 cm. and over.

No ossification centers in the carpal bones were seen in children of less than 44 cm. in length. The os capitatum was present in approxi-

mately one-tenth of all cases having a body-length between 44 and 52 cm. and in about one-quarter of cases of 52 cm. and over. The os hamatum was present in about 6 per cent of cases between 44 and 52 cm. and in about 1 case in 8 of children of 52 cm. and over.

### RELATION OF OSSIFICATION TO BODY WEIGHT

The relation of ossification of the various centers under consideration to the weight of the body is shown in detail in Table V, which is of the same general arrangement as Table IV. The various centers will be considered in the order of their appearance.

The inferior femoral epiphysis was present in all of our series, of both sexes, which had a birth weight of 2500 grams or over. In the group of lightest cases (having a birth-weight of 2000 to 2500 grams) the center was present in 50 per cent of the females and in 75 per cent of the males, or in approximately 67 per cent of all cases of this weight. As 2500 grams is probably to be regarded as a very low limit for the normal weight of full-term infants it is probably safe to say that practically all newborn children who exceed the minimum birth weight of maturity possess the inferior femoral epiphysis.

The superior tibial epiphysis also shows a close relation to body-weight. It was absent in all of the females under 2500 grams in weight, in three-fourths of the males and in five-sixths of the total number of cases in this group. The center was present in 83 per cent of children of 2500 grams and over and in 85 per cent of children of 3000 grams or over. It was constantly present only in our group of heaviest cases (4000 grams or over). Thus this center may be expected in approximately five-sixths of all newborn children of mature birth-weight.

These results may be compared with those of Pozier (1912) who also studied the ossification of the knee centers of the newborn by means of radiography. He found the inferior femoral center present in 72 per cent of cases having a birth-weight between 2000 and 2500 grams but only in children of 4000 grams and above was the center constantly present. The average weight of the newborn in Paris is distinctly less than that which has been noted in Minneapolis (approximately 3.23 kg. as compared with 3.38 kg.). This difference might account for the greater frequency of ossification in the group of lighter children but it offers no explanation for the lower frequency of ossification in children of medium weight. The same condition is true for the superior tibial epiphysis since Pozier found this center present in approximately the same per cent of lighter cases as we did, while it was present in a distinctly lower percentage of children of medium weight (3000 to 4000 grams). In the main the results of Pozier and the present findings agree in that frequency of the center is fairly closely related to body-weight.

The os cuboideum, when regarded without distinction of sex, also shows a close correlation to body-weight. It was present in approximately one-sixth of all cases between 2000 and 2500 grams and is found in a progressively increasing percentage of cases up to the group of greatest body-weight (4000 grams and over) where it is noted in about 3 cases out of 5.

The os capitatum (os magnum) was not found in any cases having a body-weight under 2500 grams. It was present in about one-sixth of all cases between 2500 and 4000 grams showing very little correlation with body-weight within these limits. In the group of cases of 4000 grams and over it was present in three cases out of five,—the same frequency as was observed for the os cuboideum.

The os hamatum showed much the same character in its distribution, although it was less frequent than the os cuboideum or os capitatum. It was present in no cases having a body-weight of less than 2500 grams, in about one case in 20 of the children weighing between 2500 and 4000 grams and in 2 out of 5 of the children of 4000 grams and over.

### THE RELATION OF OSSIFICATION TO MENSTRUAL AGE

We have estimated the length of gestation of our cases from the menstrual histories, the period of conception being calculated from the first day of the last menstrual period. The relation between body-weight, body-length and the frequency of the various ossification centers to the duration of pregnancy, as determined by this criterion, is shown in Table VI. In this table we have arranged the material in eight groups of ten day periods of menstrual age.

Roughly three-fourths of our cases fall in Groups V, VI and VII ranging in menstrual age from 270 to 300 days. Within these limits the relation between the average body-weight, average body-length and menstrual age is quite constant as both of these values rise steadily with the increasing menstrual age. The percentage frequency of the various centers of ossification studied also shows a close correlation with menstrual age in these groups. The only instance in which the frequency of ossification did not rise with increasing age was in the case of the os hamatum in Groups VI and VII where the cases in which the center was present were less numerous in the larger group. This is probably a chance variation due to the small number of instances in which this center was present.

If, however, one examines the *entire* series of cases the constancy of the relation of menstrual age to bodily development (length and weight) and skeletal development is much less evident and certain striking exceptions appear. This is true of both the younger and the older groups of children. In Group III (250 to 260 days) the body-weight is greater than in any succeeding group and both the body-

TABLE IV

FREQUENCY OF OSSIFICATION OF THE INFERIOR FEMORAL EPIPHYSIS, SUPERIOR TIBIAL EPIPHYSIS, OS CUBOIDEUM, OS CAPITATUM AND OS HAMATUM IN 100 NEWBORN CHILDREN ARRANGED ACCORDING TO BODY-LENGTH

| SEX | BODY-LENGTH (CM) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION OF: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | INFERIOR FEMORAL EPIPHYSIS | | SUPERIOR TIBIAL EPIPHYSIS | | OS CUBOIDEUM | | OS CAPITATUM (MAGNUM) | | OS HAMATUM (UNCIFORM) | |
| | | | No. | % | No. | % | No. | % | No. | % | No. | % |
| Females | 40 to 44 | 2 | 1 | (50) | 1 | (50) | 2 | (100) | 0 | (0) | 0 | (0) |
| | 44 to 48 | 5 | 5 | (100) | 2 | (40) | 1 | (20) | 1 | (20) | 1 | (20) |
| | 48 to 52 | 27 | 27 | (100) | 24 | (89) | 12 | (44) | 4 | (15) | 3 | (11) |
| | 52 and over | 11 | 11 | (100) | 10 | (91) | 5 | (45) | 1 | (9) | 1 | (9) |
| | All females | 45 | 44 | (98) | 37 | (82) | 20 | (44) | 6 | (13) | 5 | (11) |
| Males | 40 to 44 | 2 | 1 | (50) | 0 | (0) | 0 | (0) | 0 | (0) | 0 | (0) |
| | 44 to 48 | 4 | 4 | (100) | 2 | (50) | 1 | (25) | 1 | (25) | 0 | (0) |
| | 48 to 52 | 28 | 28 | (100) | 23 | (82) | 8 | (29) | 1 | (4) | 0 | (0) |
| | 52 and over | 21 | 21 | (100) | 17 | (81) | 9 | (43) | 7 | (33) | 3 | (14) |
| | All Males | 55 | 54 | (98) | 42 | (76) | 18 | (33) | 9 | (16) | 3 | (6) |
| Both Sexes | 40 to 44 | 4 | 2 | (50) | 1 | (25) | 2 | (50) | 0 | (0) | 0 | (0) |
| | 44 to 48 | 9 | 9 | (100) | 4 | (44) | 2 | (22) | 2 | (22) | 1 | (1) |
| | 48 to 52 | 55 | 55 | (100) | 47 | (85) | 20 | (36) | 5 | (9) | 3 | (6) |
| | 52 and over | 32 | 32 | (100) | 27 | (84) | 14 | (44) | 8 | (25) | 4 | (13) |
| | All Cases | 100 | 98 | (98) | 79 | (79) | 38 | (38) | 15 | (15) | 8 | (8) |

TABLE V

FREQUENCY OF OSSIFICATION OF THE INFERIOR FEMORAL EPIPHYSIS, SUPERIOR TIBIAL EPIPHYSIS, OS CUBOIDEUM, OS CAPITATUM AND OS HAMATUM IN 100 NEWBORN CHILDREN ARRANGED ACCORDING TO BODY-WEIGHT

| SEX | BODY WEIGHT (KG) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION OF: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | INFERIOR FEMORAL EPIPHYSIS | | SUPERIOR TIBIAL EPIPHYSIS | | OS CUBOIDEUM | | OS CAPITATUM (MAGNUM) | | OS HAMATUM (UNCIFORM) | |
| | | | No. | % | No. | % | No. | % | No. | % | No. | % |
| Females | 2.0 to 2.5 | 2 | 1 | (50) | 0 | (0) | 1 | (50) | 0 | (0) | 0 | (0) |
| | 2.5 to 3.0 | 7 | 7 | (100) | 4 | (57) | 2 | (29) | 1 | (14) | 1 | (14) |
| | 3.0 to 3.5 | 21 | 21 | (100) | 18 | (86) | 6 | (29) | 2 | (10) | 2 | (10) |
| | 3.5 to 4.0 | 11 | 11 | (100) | 11 | (100) | 9 | (82) | 1 | (9) | 1 | (9) |
| | 4.0 & over | 4 | 4 | (100) | 4 | (100) | 2 | (50) | 2 | (50) | 1 | (25) |
| | All females | 45 | 44 | (98) | 37 | (82) | 20 | (44) | 6 | (13) | 5 | (11) |
| Males | 2.0 to 2.5 | 4 | 3 | (75) | 1 | (25) | 0 | (0) | 0 | (0) | 0 | (0) |
| | 2.5 to 3.0 | 4 | 4 | (100) | 3 | (75) | 0 | (0) | 0 | (0) | 0 | (0) |
| | 3.0 to 3.5 | 21 | 21 | (100) | 17 | (81) | 7 | (33) | 7 | (33) | 0 | (0) |
| | 3.5 to 4.0 | 20 | 20 | (100) | 15 | (75) | 7 | (40) | 3 | (15) | 0 | (0) |
| | 4.0 & over | 6 | 6 | (100) | 6 | (100) | 4 | (67) | 4 | (67) | 3 | (50) |
| | All Males | 55 | 54 | (98) | 42 | (76) | 18 | (33) | 14 | (25) | 3 | (6) |
| Both Sexes | 2.0 to 2.5 | 6 | 4 | (67) | 1 | (17) | 1 | (17) | 0 | (0) | 0 | (0) |
| | 2.5 to 3.0 | 11 | 11 | (100) | 7 | (64) | 2 | (18) | 1 | (9) | 1 | (9) |
| | 3.0 to 3.5 | 42 | 42 | (100) | 35 | (83) | 13 | (31) | 9 | (21) | 2 | (5) |
| | 3.5 to 4.0 | 31 | 31 | (100) | 26 | (84) | 16 | (55) | 4 | (13) | 1 | (3) |
| | 4.0 & over | 10 | 10 | (100) | 10 | (100) | 6 | (60) | 6 | (60) | 4 | (40) |
| | All Cases | 100 | 98 | (98) | 79 | (79) | 38 | (38) | 20 | (20) | 8 | (8) |

length and the ossification is much further advanced than one might expect from the apparent duration of pregnancy. In Group II while

TABLE VI

FREQUENCY OF OSSIFICATION OF THE INFERIOR FEMORAL EPIPHYSIS, SUPERIOR TIBIAL EPIPHYSIS, OS CUBOIDEUM, OS CAPITATUM AND OS HAMATUM IN 100 NEWBORN CHILDREN ARRANGED ACCORDING TO MENSTRUAL AGE

| GROUP NUMBER | NUMBER OF CASES | RANGE OF MENSTRUAL AGE (DAYS) | AVERAGE MENSTRUAL AGE (DAYS) | AVERAGE BODY-WEIGHT (GM.) | AVERAGE TOTAL BODY-LENGTH (CM.) | FREQUENCY OF: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | INFERIOR FEMORAL EPIPHYSIS | | SUPERIOR TIBIAL EPIPHYSIS | | CUBOID | | OS CAPITATUM | | OS HAMATUM | |
| | | | | | | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT |
| I | 2 | 230-240 | 235 | 2068 | 43 | 1 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| II | 3 | 240-250 | 248 | 2525 | 45 | 3 | 100 | 3 | 100 | 2 | 67 | 0 | 0 | 0 | 0 |
| III | 4 | 250-260 | 256 | 3708 | 50.5 | 4 | 100 | 3 | 75 | 1 | 25 | 1 | 25 | 0 | 0 |
| IV | 8 | 260-270 | 264 | 3205 | 50 | 8 | 100 | 5 | 63 | 2 | 25 | 1 | 12 | 1 | 12 |
| V | 25 | 270-280 | 275 | 3318 | 49.5 | 24 | 96 | 20 | 80 | 5 | 20 | 2 | 8 | 1 | 4 |
| VI | 35 | 280-290 | 284 | 3476 | 50.5 | 34 | 97 | 28 | 80 | 11 | 31 | 5 | 14 | 3 | 9 |
| VII | 14 | 290-300 | 293 | 3555 | 51 | 14 | 100 | 14 | 100 | 12 | 86 | 3 | 21 | 2 | 7 |
| VIII | 7 | 300 & over | 305 | 3335 | 51 | 7 | 100 | 6 | 86 | 5 | 71 | 2 | 29 | 2 | 29 |

TABLE VII

COMPARATIVE FREQUENCY OF THE OSSIFICATION OF THE SUPERIOR TIBIAL EPIPHYSIS, THE INFERIOR FEMORAL EPIPHYSIS AND THE OS CUBOIDEUM IN MALE AND FEMALE FETUSES AND NEWBORN CHILDREN CLASSIFIED BY TOTAL BODY-LENGTH

| BODY-LENGTH (CM.) | INFERIOR FEMORAL EPIPHYSIS | | | | SUPERIOR TIBIAL EPIPHYSIS | | | | OS CUBOIDEUM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MALES | | FEMALES | | MALES | | FEMALES | | MALES | | FEMALES | |
| | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) | NUMBER OF CASES | FREQUENCY OF OSSIFICATION (PER CENT) |
| 40 to 45 | 25 | 16.0 | 26 | 30.8 | 23 | 0.0 | 20 | 10.0 | 17 | 0.0 | 19 | 10.5 |
| 45 to 50 | 113 | 78.7 | 109 | 92.6 | 100 | 37.0 | 102 | 53.8 | 31 | 12.7 | 33 | 33.3 |
| 50 to 55 | 127 | 96.0 | 97 | 98.9 | 122 | 83.0 | 91 | 85.9 | 54 | 33.3 | 47 | 53.2 |
| 55 and over | 13 | 100.0 | 2 | 100.0 | 13 | 100.0 | 1 | 100.0 | 5 | 100.0 | — | —— |

the body-length and body-weight are in keeping with the supposed age the ossification is much in advance of it. On the other hand the body-weight of Group VIII (300 days and over) is distinctly below the average weight in Groups III, VI and VII (250 to 260, 280 to 290 and 290 to 300 days respectively) and corresponds quite closely to that of Group V (270 to 280 days). The body-length corresponds quite closely to that of Groups III, VI and VII. The frequency of the ossification of the superior tibial epiphysis and the os cuboideum is distinctly less than in the preceding (and presumably younger group of cases) although the frequency of the ossification of the bones of the wrist is somewhat greater.

TABLE VIII

COMPARATIVE FREQUENCY OF THE INFERIOR FEMORAL EPIPHYSIS IN MALES AND FEMALES IN LATER FETAL LIFE AND AT BIRTH

| BODY-LENGTH | FEMALES | | | MALES | | |
|---|---|---|---|---|---|---|
| | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER |
| Group A<br>Males—40 to 45 cm.<br>Females—39 to 44 cm. | 26 | 7 | 25.9 | 25 | 4 | 16.0 |
| Group B<br>Males—45 to 50 cm.<br>Females—44 to 49 cm. | 76 | 67 | 88.1 | 113 | 89 | 78.7 |
| Group C<br>Males 50 to 55 cm.<br>Females—49 to 54 cm. | 124 | 122 | 98.4 | 127 | 122 | 96.0 |
| Group D<br>Males—55 cm. and over<br>Females—54 cm. and over | 5 | 5 | 100 | 13 | 13 | 100 |

TABLE IX

COMPARATIVE FREQUENCY OF THE SUPERIOR TIBIAL EPIPHYSIS IN MALES AND FEMALES IN LATER FETAL LIFE AND AT BIRTH

| BODY-LENGTH | FEMALES | | | MALES | | |
|---|---|---|---|---|---|---|
| | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER |
| Group A<br>Males—40 to 45 cm.<br>Females—39 to 44 cm. | 17 | 1 | 6.0 | 23 | 0 | 0.0 |
| Group B<br>Males—45 to 50 cm.<br>Females—44 to 49 cm. | 71 | 33 | 46.5 | 100 | 37 | 37.0 |
| Group C<br>Males—50 to 55 cm.<br>Females—49 to 54 cm. | 125 | 97 | 77.6 | 122 | 89 | 83.0 |
| Group D<br>Males—55 cm. and over<br>Females—54 cm. and over | 4 | 4 | 100.0 | 13 | 13 | 100.0 |

These discrepancies in body-weight, body-length and in the state of the ossification centers in the outlying groups of children when classified by menstrual age seem to us to indicate the great inaccuracies in determining the age of apparently premature and postmature children from the date of the last menstruation alone. This error is evidently twofold, for we find a group of relatively mature children with an average menstrual age of nearly one lunar month (24 days) less than the general average and a group of relatively immature children with an average menstrual age nearly one lunar month (25 days) above the average of all cases. While undoubtedly, in certain instances, the children of these outlying groups are definitely premature or postmature the majority of cases fall in these groups because of inaccuracies in determining the exact duration of prenatal life from the menstrual data. In Group III in particular menstruation probably occurred after conception had taken place, while in Group VIII a menstrual period may have been missed before conception occurred. This speculation would hold true even if we accept the modern opinion that a pregnancy may begin at any time in the intermenstrual period.

As previously stated, we believe that our records of menstrual history are quite accurate for they were obtained by careful inquiry from intelligent patients in private practice. Certainly they are much more precise than the general type of records secured in large maternities accepting all classes. We feel that our data add further evidence of the frequent unreliability of menstrual age, and another argument against the induction of labor at a predetermined date based on the menstrual history.

TABLE X

COMPARATIVE FREQUENCY OF THE CENTER OF OSSIFICATION OF THE CUBOID IN MALES AND FEMALES IN LATER FETAL LIFE AND AT BIRTH

| BODY-LENGTH | FEMALES | | | MALES | | |
|---|---|---|---|---|---|---|
| | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER | TOTAL NUMBER OF CASES | NUMBER OF CASES SHOWING CENTER | PER CENT OF CASES SHOWING CENTER |
| Group A<br>Males—40 to 45 cm.<br>Females—39 to 44 cm. | 12 | 2 | 16.7 | 17 | 0 | 0 |
| Group B<br>Males—45 to 50 cm.<br>Females—44 to 49 cm. | 33 | 5 | 15.1 | 31 | 4 | 13 |
| Group C<br>Males—50 to 55 cm.<br>Females—49 to 54 cm. | 77 | 29 | 37.7 | 54 | 18 | 33 |
| Group D<br>Males—55 cm. and over<br>Females—54 cm. and over | 5 | 1 | 20.0 | 5 | 5 | 100 |

### RELATION OF OSSIFICATION TO SEX

It is well known that in postnatal life the development of the skeleton proceeds at a more rapid rate and is completed sooner in females than in males. This has been brought out particularly clearly by Pryor's studies on carpal ossification where it was found that certain of the bones which appear rather late in childhood may be present a year or more earlier in the female than in the male. Apparently no study has been made to determine whether this precosity in development of the female exists in the intrauterine life. We have made an attempt to analyze our material from the standpoint of sex by

TABLE XI

COMPARATIVE FREQUENCY OF THE OSSIFICATION OF THE CENTERS OF THE WRIST, KNEE AND ANKLE IN FIRST-BORN AND LATER CHILDREN AT BIRTH

| CENTER | MALES (52) | | | | FEMALES (43) | | | | BOTH SEXES | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FIRST-BORN (39) | | LATER CHILDREN (13) | | FIRST-BORN (25) | | LATER CHILDREN (18) | | FIRST-BORN (64) | LATER CHILDREN (31) |
| | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT | PER CENT | PER CENT |
| Inferior femoral epiphysis | 38 | 97.4 | 13 | 100 | 25 | 100 | 18 | 100 | 98.4 | 100 |
| Superior tibial epiphysis | 33 | 84.6 | 8 | 61.5 | 19 | 76.0 | 17 | 94.4 | 81.2 | 80.6 |
| Cuboid | 11 | 28.2 | 4 | 30.7 | 12 | 48.0 | 7 | 38.9 | 35.9 | 35.5 |
| Os capitatum | 4 | 10.2 | 4 | 30.7 | 5 | 20.0 | 1 | 5.6 | 14.0 | 16.1 |
| Os hamatum | 2 | 5.1 | 0 | 0 | 4 | 16.0 | 1 | 5.6 | 9.4 | 3.2 |

TABLE XII

TABLE SHOWING THE RELATIVE PERCENTAGE PRESENCE AND ABSENCE FREQUENCY OF THE OSSIFICATION OF THE SUPERIOR TIBIAL EPIPHYSIS, INFERIOR FEMORAL EPIPHYSIS, OS CUBOIDEUM, OS CAPITATUM, AND OS HAMATUM IN 100 NEWBORN CHILDREN

| | OS HAMATUM PRESENT | OS HAMATUM ABSENT | OS CAPITATUM PRESENT | OS CAPITATUM ABSENT | CUBOID PRESENT | CUBOID ABSENT | SUP. TIBIAL EPI. PRESENT | SUP. TIBIAL EPI. ABSENT |
|---|---|---|---|---|---|---|---|---|
| Os capitatum present | 9 | 6 | | | | | | |
| Os capitatum absent | 0 | 85 | | | | | | |
| Cuboid present | 9 | 29 | 13 | 25 | | | | |
| Cuboid absent | 0 | 62 | 2 | 60 | | | | |
| Sup. tibial epi. present | 9 | 72 | 15 | 66 | 36 | 45 | | |
| Sup. tibial epi. absent | 0 | 19 | 0 | 19 | 2 | 17 | | |
| Int. femoral epi. present | 9 | 89 | 15 | 83 | 37 | 61 | 81 | 17 |
| Int. femoral epi. absent | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 2 |

grouping it in tables arranged on the basis of period of gestation as determined from the last menstruation, and on body-length. On the last basis we have also made a combined table including all the data of this kind available to us from the literature.

Due to the sources of error in calculating the length of gestation which have been pointed out in a preceding paragraph the analysis of sex differences in ossification based upon the menstrual age gives inconclusive results and on this basis alone no definite and consistent differences in sex could be determined.

The sexual differences in the frequency of ossification in material arranged according to body-length are shown in Tables VII, VIII, IX and X. Table VII shows that when specimens of the two sexes are arranged in groups of equal body-length the frequency of ossification of the various centers is distinctly greater in the females of all groups under 55 cm. than in males. It should be remembered, however, that newborn females average approximately 1 cm. less in total body-length than males and that therefore late female fetuses having the same length as males may be somewhat more mature. In Tables VIII, IX and X we have attempted to allow for this difference by making the range of body-length of the females 1 cm. lower in each group than the range of the males of the same group. If these tables are examined it will be noted that even with this correction the percentage frequency of ossification in the females is greater in the majority of instances than in males of the corresponding group. This higher percentage of ossification of the females is particularly noticeable in the shorter and younger groups and in those centers which are not ossified in all cases at birth.

### RELATION OF OSSIFICATION TO PARITY

It is well known that both the average weight and the average total length of the newborn of multiparæ is somewhat greater than that of first-born children and this difference has been attributed to a supposed greater length of the prenatal period in the former. *A priori* one might expect to find this greater general development and (supposed) greater maturity accompanied by a more advanced skeletal development. Pryor (1908), however, in his studies on the postnatal ossification of the wrist, found that carpal ossification was more advanced in first-born than in subsequent children. We are certain of the parity of 95 of our cases of which 64 were primiparæ and 31 were multiparæ. The comparative frequency of the ossification centers in these two groups is shown in Table XI below. As will be seen from the examination of this table there are no consistent differences between the two classes with the exception of the os hamatum which was present in 9.4 per cent of the first born and only 3.2 per cent of the later born, and the small number of cases in which the os hamatum

occurs makes the significance of this difference quite open to question. In the latter 47.1 per cent of the greatest possible number of centers were present and in the former 47.8 per cent. While the absolute degree of ossification is practically the same in the two classes, it may be suggested that if the supposition is correct that children of multiparae have a longer period of gestation on the average than the children of primiparæ, then ossification is *relatively* more advanced in the latter class. This supposition would be in accord with the observations of Pryor cited above.

## VARIATIONS AND IRREGULARITIES IN OSSIFICATION

Taken as a whole, ossification was extremely regular in our material. This falls in line with the experience of Pryor (1908) who has emphasized the regularity of postnatal ossification in the carpus, and with the findings of Pozier (1912) regarding the natal ossification of

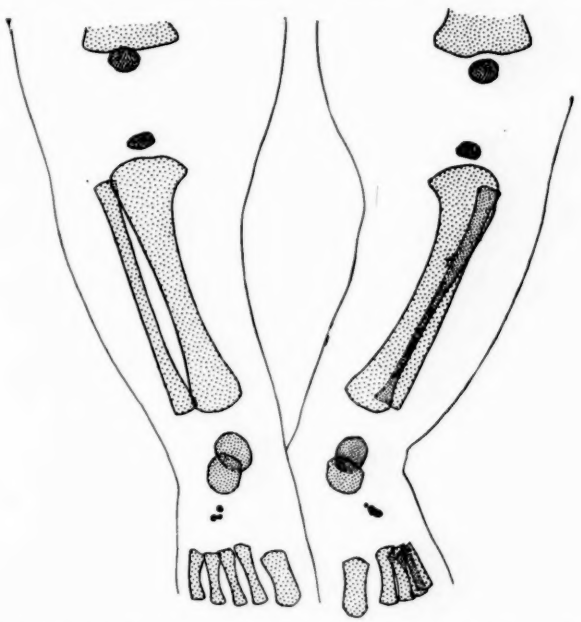

Fig. 6.—Tracing of a radiogram of the lower extremities of a male newborn of 309 days' gestation, having a birth weight of 5060 grams and a total length of 55 cm. Three centers for the cuboid on either side.

the knee. The most variable of the bones studied was the cuboid. This bone is generally described as ossifying from 2 to 3 centers. Hasselwander (1909), who has made the most complete study of the ossification of the cuboid, found a single center 24 times in 47 cases, a double center 19 times (in which a possible third was indicated 4 times), and 3 definite centers in 4 cases. In our material the number of centers was much more variable, there being several cases in which 4 or 5 centers were present, and one instance in which 7 ossific granules could be

grouping it in tables arranged on the basis of period of gestation as determined from the last menstruation, and on body-length. On the last basis we have also made a combined table including all the data of this kind available to us from the literature.

Due to the sources of error in calculating the length of gestation which have been pointed out in a preceding paragraph the analysis of sex differences in ossification based upon the menstrual age gives inconclusive results and on this basis alone no definite and consistent differences in sex could be determined.

The sexual differences in the frequency of ossification in material arranged according to body-length are shown in Tables VII, VIII, IX and X. Table VII shows that when specimens of the two sexes are arranged in groups of equal body-length the frequency of ossification of the various centers is distinctly greater in the females of all groups under 55 cm. than in males. It should be remembered, however, that newborn females average approximately 1 cm. less in total body-length than males and that therefore late female fetuses having the same length as males may be somewhat more mature. In Tables VIII, IX and X we have attempted to allow for this difference by making the range of body-length of the females 1 cm. lower in each group than the range of the males of the same group. If these tables are examined it will be noted that even with this correction the percentage frequency of ossification in the females is greater in the majority of instances than in males of the corresponding group. This higher percentage of ossification of the females is particularly noticeable in the shorter and younger groups and in those centers which are not ossified in all cases at birth.

### RELATION OF OSSIFICATION TO PARITY

It is well known that both the average weight and the average total length of the newborn of multiparæ is somewhat greater than that of first-born children and this difference has been attributed to a supposed greater length of the prenatal period in the former. *A priori* one might expect to find this greater general development and (supposed) greater maturity accompanied by a more advanced skeletal development. Pryor (1908), however, in his studies on the postnatal ossification of the wrist, found that carpal ossification was more advanced in first-born than in subsequent children. We are certain of the parity of 95 of our cases of which 64 were primiparæ and 31 were multiparæ. The comparative frequency of the ossification centers in these two groups is shown in Table XI below. As will be seen from the examination of this table there are no consistent differences between the two classes with the exception of the os hamatum which was present in 9.4 per cent of the first born and only 3.2 per cent of the later born, and the small number of cases in which the os hamatum

occurs makes the significance of this difference quite open to question. In the latter 47.1 per cent of the greatest possible number of centers were present and in the former 47.8 per cent. While the absolute degree of ossification is practically the same in the two classes, it may be suggested that if the supposition is correct that children of multiparae have a longer period of gestation on the average than the children of primiparæ, then ossification is *relatively* more advanced in the latter class. This supposition would be in accord with the observations of Pryor cited above.

## VARIATIONS AND IRREGULARITIES IN OSSIFICATION

Taken as a whole, ossification was extremely regular in our material. This falls in line with the experience of Pryor (1908) who has emphasized the regularity of postnatal ossification in the carpus, and with the findings of Pozier (1912) regarding the natal ossification of

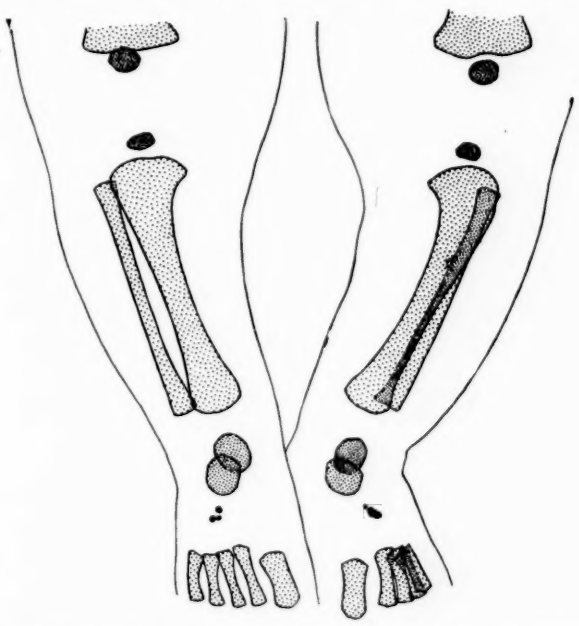

Fig. 6.—Tracing of a radiogram of the lower extremities of a male newborn of 309 days' gestation, having a birth weight of 5060 grams and a total length of 55 cm. Three centers for the cuboid on either side.

the knee. The most variable of the bones studied was the cuboid. This bone is generally described as ossifying from 2 to 3 centers. Hasselwander (1909), who has made the most complete study of the ossification of the cuboid, found a single center 24 times in 47 cases, a double center 19 times (in which a possible third was indicated 4 times), and 3 definite centers in 4 cases. In our material the number of centers was much more variable, there being several cases in which 4 or 5 centers were present, and one instance in which 7 ossific granules could be

recognized. In the young bone the centers appear in the radiograph as a small cluster of minute particles, and the irregular form of this center in older specimens indicates the fusion of these masses which were originally discrete. Quite commonly two or three large centers may be observed for some time after ossification has been in progress, and often the bone has a bifid form in the radiograph. These peculiarities are illustrated in Figs. 6 to 14. We found not only the greatest irregularity in the number and shape of the centers in different specimens but also on the different sides of the same specimen. Examples of this asymmetry are shown in Figs. 7 and 8.

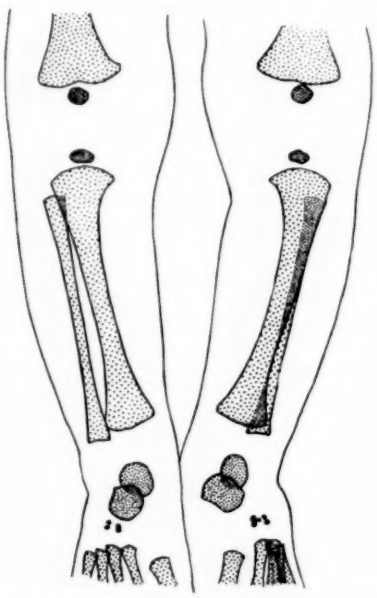

Fig. 7.—Tracing of a radiogram of the lower extremities of a female newborn of 277 days' gestation, having a birth weight of 2710 grams and a total length of 46 cm. Four centers of ossification in the right cuboid, 5 in the left.

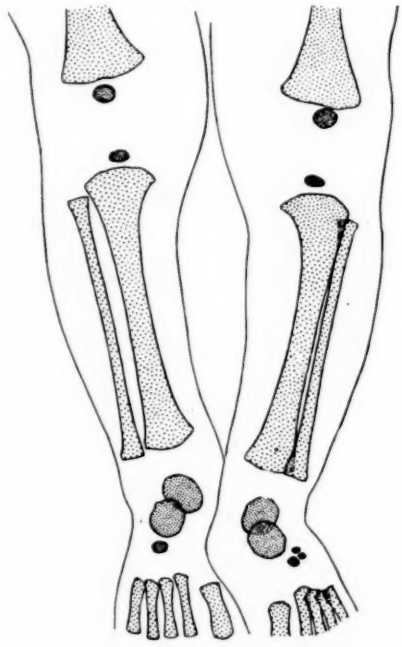

Fig. 8.—Tracing of a radiogram of the lower extremities of a female newborn of 294 days' gestation, having a birth weight of 3525 grams and a total length of 51 cm. One large cuboid center on the right and 3 centers of the cuboid on the left ankle. Knee centers small for a newborn child of this degree of development.

The os capitatum also showed some bilateral irregularity. It was present in three instances on the right side only and in three instances on the left side only. This disagrees with Pryor's finding that the ossification of the wrist is always symmetrical. The os capitatum was double in two cases and in one case it was bifid.

Table XII is arranged to show definitely the percentages of presence and absence of the different ossific centers and to visualize the occurrence and nonoccurrence of each of the centers in relation to the others in the series. This table shows that the inferior femoral center was the one most

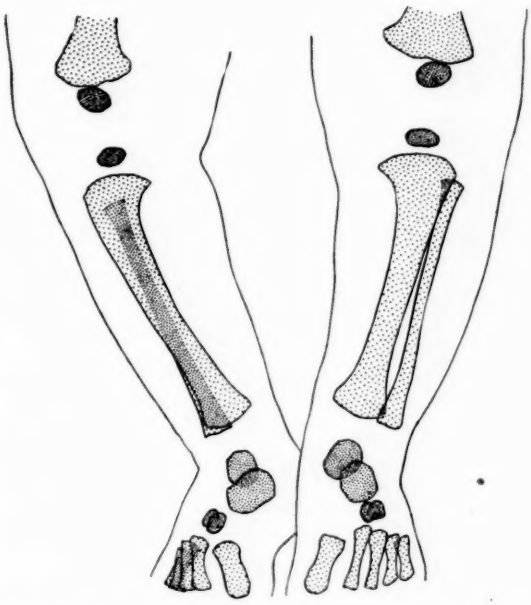

Fig. 9.—Tracing of a radiogram of the lower extremities of a female newborn of 289 days' gestation, having a birth weight of 4155 grams and a total length of 51.5 cm. Large bifed centers of the cuboid on both sides.

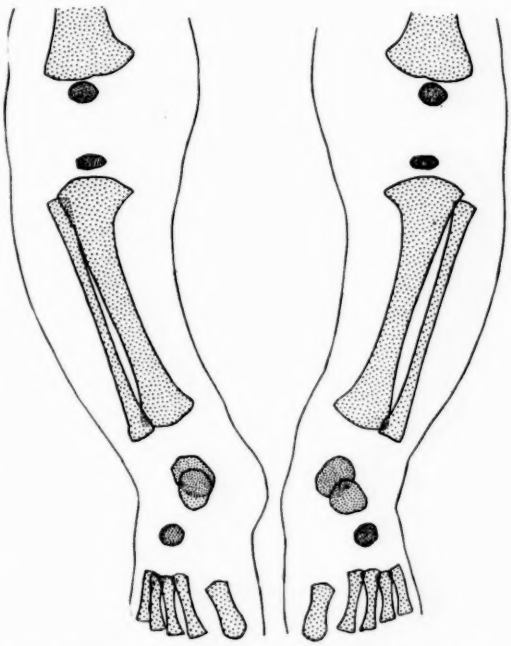

Fig. 10.—Tracing of a radiogram of the lower extremities of male infant of 267 days' gestation, having a birth weight of 4225 grams and a total length of 55 cm. Large single center of the cuboid of both sides.

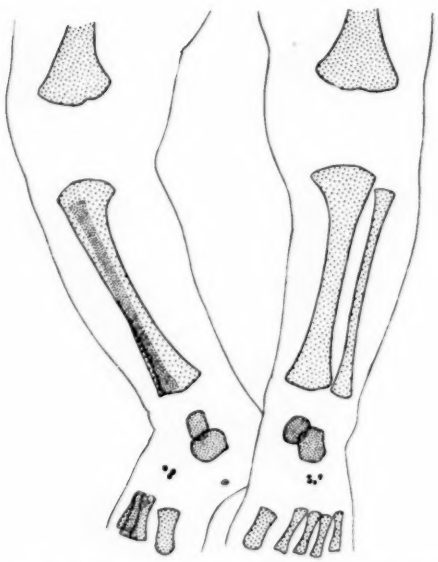

Fig. 11.—Tracing of a radiogram of the lower extremities of a female newborn of 281 days' gestation, having a birth weight of 2185 grams and a total length of 43 cm. No knee centers, but cuboid centers on either side despite a low body weight and body length.

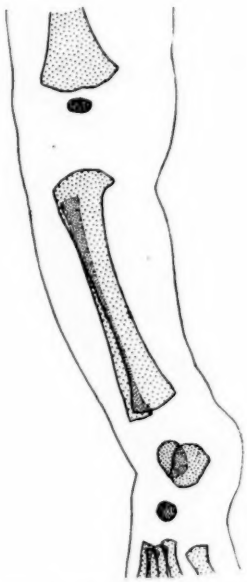

Fig. 12.—Tracing of a radiogram of the right leg of a male newborn of 265 days' gestation, having a birth weight of 3035 grams and a total length of 51 cm. No superior tibial center but a large single cuboid center.

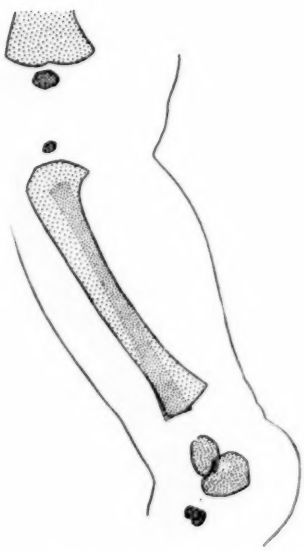

Fig. 13.—Tracing of a radiogram of the right leg of a male newborn of 285 days' gestation, having a birth weight of 4295 grams and a total length of 55 cm. Newborn of unusually large dimensions with relatively small knee centers but highly developed bifid cuboid center.

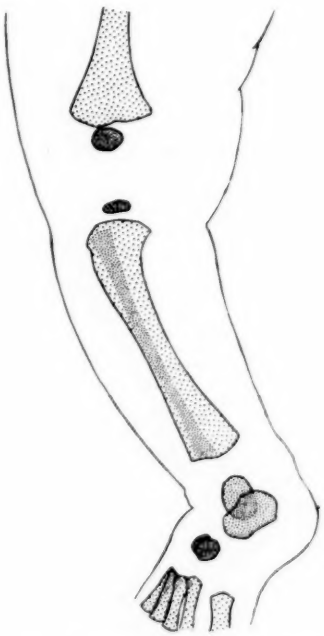

Fig. 14.—Tracing of a radiogram of the right leg of a female newborn of 292 days' gestation, having a birth weight of 4110 grams and a total length of 51.5 cm. Specimen of great weight with advanced development of knee and cuboid centers, the latter being double.

constantly present, being found in 98 of the 100 cases. The other centers were present with varying frequency in association with the inferior femoral, as follows: Superior tibial in 81; cuboid in 37; os capitatum in 15 and os hamatum in 9 of the 98 cases in which the inferior femoral was present. These same centers were absent in a considerable number of those cases in which the inferior femoral was present, as may be seen from the following figures: the superior tibial was absent in 17, the cuboid in 61, the os capitatum in 83, and the os hamatum in 89 of the 98 instances in which the inferior femoral was present. With the exception of the occurrence of the cuboid in one case the other centers were uniformly absent when the inferior femoral epiphysis was not ossified.

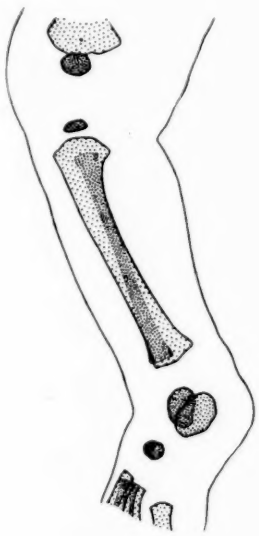

Fig. 15.—Tracing of a radiogram of the right leg of a female newborn of 312 days' gestation, having a birth weight of 3090 grams and a total length of 48 cm.

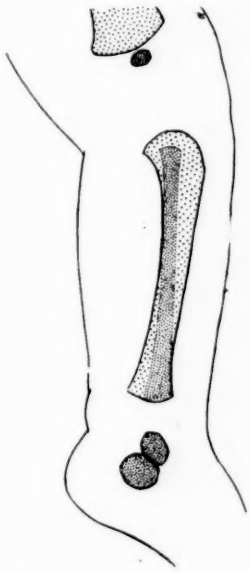

Fig. 16.—Tracing of a radiogram of the left leg of a male newborn of 287 days' gestation, having a birth weight of 3600 grams and a total length of 53.5 cm. A specimen of more than the usual newborn dimensions with no ossification of the cuboid or superior tibial epiphysis.

The superior tibial center was present in 81 cases in which the inferior femoral was constantly present, and the cuboid, capitatum and hamatum occurred 36, 15, and 9 times respectively. This center was absent in 19 cases of the series. In these the inferior femoral occurred in 17 and the cuboid in only 2, and no wrist centers were present. The presence of the cuboid in the absence of the superior tibial epiphysis may be regarded as quite unusual.

The cuboid center appeared 38 times. In these the centers of the inferior femoral, superior tibial, os capitatum and os hamatum were present in the following number of cases: 37, 36, 13, 9. It was never the only

center present but was one of only two centers in one instance. The cuboid was absent from 62 cases and in these the inferior femoral was present in 65, the superior tibial in 45, the capitatum in 2 while the hamatum was always absent. The inferior femoral was absent in 1, the superior tibial in 17, the capitatum in 60 and the hamatum in all of the instances (62) where the cuboid was absent.

Fig. 17.

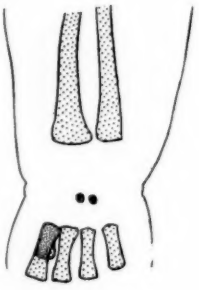

Fig. 18.

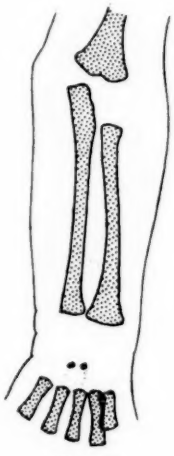

Fig. 19.

Fig. 20.

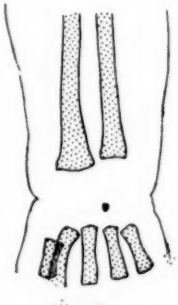

Fig. 21.

Fig. 22.

Fig. 17.—Tracing of a radiogram of the wrist of a female newborn of 287 days' gestation having a birth weight of 3390 grams and a total length of 53 cm. Os capitatum and os hamatum present.

Fig. 18.—Tracing of a radiogram of the wrist and forearm of a male newborn of 309 days' gestation, having a birth weight of 5060 grams and a total length of 55 cm. An unusually large child with the centers for the os capitatum and os hamatum highly developed.

Fig. 19.—Tracing of a radiogram of the wrist and forearm of a female newborn of 277 days' gestation, having a birth weight of 2710 grams and a total length of 46 cm. Os hamatum and os capitatum.

Fig. 20.—Tracing of a radiogram of the wrist of a female newborn of 312 days' gestation, having a birth weight of 3090 grams and a total length of 48 cm. A small child with large os hamatum and (double) os capitatum.

Fig. 21.—Tracing of a radiogram of the wrist of a female newborn of 289 days' gestation, having a birth weight of 4165 grams and a total length of 51.5 cm. Os capitatum alone present.

Fig. 22.—Tracing of a radiogram of the wrist and forearm of a male newborn of 285 days' gestation, having a birth weight of 4295 grams and a total length of 55 cm. Os hamatum and os capitatum.

The center of the os capitatum was in evidence in 15 cases, in all of which the inferior femoral and the superior tibial centers were present. The cuboid appeared in 12 and the hamatum in 9 of the cases. All of the other centers were present in all of these instances. The os capitatum was seen in no case when the inferior femoral or superior tibial were absent but its presence was noted twice in the absence of the cuboid (which may be considered as somewhat anomalous) and it was present in 6 instances where the hamatum was absent.

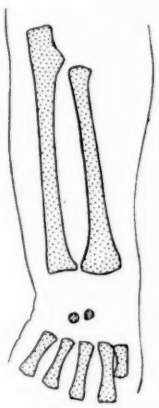

Fig. 23.

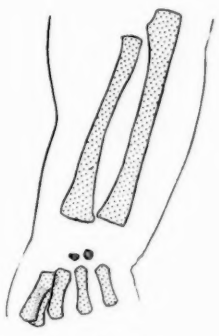

Fig. 24.

Fig. 25.

Fig. 23.—Tracing of a radiogram of the wrist and forearm of a female newborn of 281 days' gestation, having a birth weight of 3950 grams and a total length of 49 cm. Usually large centers of the os hamatum and os capitatum.

Fig. 24.—Tracing of a radiogram of the wrist and forearm of a female newborn of 292 days' gestation, having a birth weight of 4110 grams and a total length of 51.5 cm. Large os hamatum and os capitatum.

Fig. 25.—Tracing of a radiogram of the wrist and forearm of a male newborn of 267 days' gestation, having a birth weight of 4225 grams and a total length of 55 cm. Os hamatum and (double) os capitatum.

The os hamatum was demonstrable in 9 of our series of cases. All of the other centers were present in every one of these. It was absent in 91 cases, the inferior femoral center was present in all of these, the superior tibial in 81, the cuboid in 38 and the capitatum in 15.

## SUMMARY

1. The inferior femoral epiphysis, judging from all available data, is present in about 1 case in 20 in the eighth fetal month, in 1 case in 3 in the ninth month, in 6 cases in 7 in the tenth month, and in about 19 cases in 20 at birth (full-term infants). If not present at birth, the center appears before the close of the first postnatal month. In our own series the center was present in 98 per cent of all newborn children.

2. The superior tibial epiphysis, judging from all available material, is almost never present before the ninth fetal month. It is found in 1 case in 17 in the ninth month, about 2 cases in 5 in the tenth month

and in about seven-eights of all full-term newborn children. It was present in 81 per cent of the cases in our series.

3. The cuboid, according to all available data, first appears at about the beginning of the ninth fetal month. It is present, on the average,

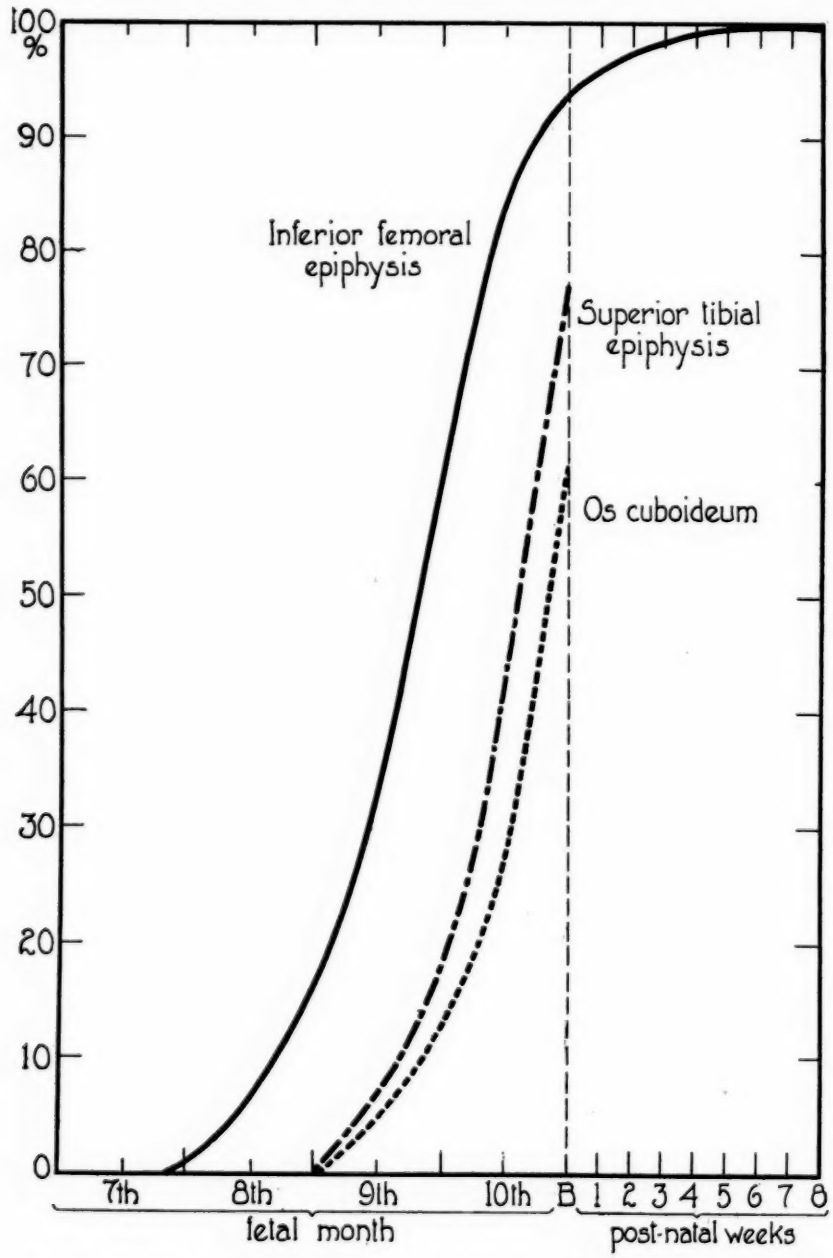


Fig. 26.—Graphs illustrating the frequency of ossification of the inferior femoral epiphysis, the superior tibial epiphysis and the os cuboideum in later fetal life. Abscissae, age. Ordinates, frequency of ossification in per cent. (Based on the material presented in Tables I, II, and III.)

in about 1 case in 25 in the ninth month, in about 1 case in 4 in the tenth month, and in about 3 cases in 5 in full-term newborn children. In our own series the center was present in a much smaller per cent of all cases than is reported by other investigators (38 per cent).

4. Two carpal ossification centers, those of the os capitatum (os magnum) and of the os hamatum (unciform), may be present in the newborn. In our series the os capitatum was present in 15 per cent and the os hamatum in 9 per cent of all cases.

5. There is a close relation between total body-length and frequency of ossification of the several centers discussed in this paper. A similar, but less close, correlation exists between frequency of ossification and the body-weight.

6. In our material the correlation of body-weight, total body-length and frequency of ossification with menstrual age was quite close for the middle members of the series ranging in menstrual age from 270 to 300 days. But the outlying cases (having a menstrual age of less than 270 or more than 300 days) show little relation between these measures of bodily development and age as determined from the menstrual history.

7. Our evidence points to the conclusion that ossification proceeds slightly more rapidly in females than in males during intrauterine life even though the weight and dimensions of the females are less than those of the males.

8. Our observations show no direct evidence of any relation between parity and the rate of ossification in intrauterine life.

9. Variations in the *number* of ossification centers present for individual bones were limited to the os capitatum and os cuboideum. The latter is formed from an extremely variable number of centers. When anomalies in the number of centers are present they are often asymmetrical.

10. Variations in the order of appearance of centers were decidedly unusual in our material, being confined to premature ossification of the os cuboideum (2 cases) and of the premature ossification os capitatum (2 cases).

11. The usual order of appearance of the centers under consideration is as follows: (a) Inferior femoral epiphysis; (b) Superior tibial epiphysis; (c) Cuboid; (d) Os capitatum; (e) Os hamatum.

## LITERATURE

Barkow, H. C. L.: Über das Vorkommen von Knochenkernen in den knorpligen Epiphyse der langen Knochen mit Beziehung auf Würdigung der Lebensfähigkeit derselben in forensischen Verhandlungen. Vierteljahrsschr. f. gerichtl. Med., 1872, xvi. Béclard, P.: Nouveau Jour. de Méd., Chir. et Pharm., 1819, iv, p. 107 et seq. Böhm: Ueber die forensische Bedeutung des Knochenkerns in der unteren Epiphyse des Oberschenkels der Neugeborenen. Vierteljahrsschr. f. gerichtl. Med., 1858, xiv. Brice, T. H.: Quain's Elements of Anatomy, 1915, vol. iv, Pt. I (Eleventh Ed.), London. Casper, J. L.: Praktisches Handbuch der gerichtlichen Medicin, 1856. (New Sydenham Society's Translation of 1869 consulted.) Corrado, G.: De' prin-

cipali nuclei di ossificazione che possono rinvenirsi all' epoca della nascita. L'Anomalo, 1891, iii, 231 to 244. Cory, R.: Notes on the Examination of the Bodies of Fifty Children Born Dead or Shortly Dying. St. Thomas's Hosp. Rep. (1877), N. S., 1878, viii, 61 to 74. Notes on the Examination of the Bodies of Fifty Children Born Dead or Shortly Dying. (Second series.) St. Thomas's Hosp. Rep. (1879), N. S., 1880, x, 263 to 276. Notes on the Examination of the Bodies of Fifty-eight Children Born Dead or Shortly Dying. (Third series.) St. Thomas's Hosp. Rep., N. S., 1897, xxiv, 131 to 150. Debierre, C.: Contribution à l'étude de l'ossification et de l'homotypie des pièces du carpe et du tarse chez l'homme. Journ. de l'Anat. et de la Physiol., 1886, xxii. Freymond, P. L. A.: Etude sur l'ossification des os du pied, faite d'après la radiographie. Thèse, Bordeaux, 1910. Filomusi-Gullfi, G.: Sul nucleo epifisario femorale. Boll. Soc. med. chir. Pavia, 1889, No. 2, 25 to 27. Fujinami, K.: Ueber die Ossifikation der Handwurzelknochen. Fortschr. a. d. Geb. Röntgenstr., 1911, xvii, 311 to 318. Graham: The Center of Ossification in the Lower Femoral Epiphysis in Relation to Forensic Medicine. Diss. Berlin, 1886. Guichard, A.: De la valeur medico-legale du point de Béclard, point d'ossification de l'extrémité inferieur du femur. Thèse, Lyon, 1905, 83 pp. Hahn, H.: Röntgenographische Untersuchungen über das Verhalten der Epiphysen der Unterschenkelknochen wahrend des Wachstums. Festschr. 70. Geburtsh. C. v. Kuppfer, 1899, iii, 731. Hartmann, G.: Beiträge zur Osteologie der Neugeborenen. Diss. Tubingen, 37 pp. 1869. Hasselwander, A.: Untersuchungen über die Ossification des menschlichen Fussskelets. Zeitschr. f. Morphol. u. Anthropol., 1909, xii, 1 to 140. Hassenstein, W.: Zur Reifebestimmung des Foetus aus dem Knochenkern der Oberschenkelepiphyses. Zeitschr. f. Medizinalbeamte, 1892, v, 129 to 132. Heimann, A. und Potpeschnigg, K.: Über die Ossification der kindlichen Hand. Jahrb. f. Kinderheilk., 1907, lxv, 437 to 456. Hess, J. H.: The diagnosis of the age of the fetus by the use of roentgenograms. Am. Jour. Dis. Child., 1917, xiv, 397 to 423. Kjölseth, M.: Untersuchungen über die Reifezeichen des neugeborenen Kindes. Monatschr. f. Geburtsh. u. Gynäk., 1913, xxxviii, (Ergänzungsh.), 216 to 298. Leopold, G. and Leisewitz, T.: Geburtshilflicher Röntgen-Atlas. Dresden, 1909. Long, E. and Caldwell, E. W.: Some Investigations Concerning the Relation Between Carpal Ossification and Physical and Mental Development. Am. Jour. Dis. Child., 1911, i, 111 to 138. Mildner, E.: Ueber die Benützung des Knochenkernes in der unteren Epiphyse des Schenkelbeins zu gerichtsärztlichen Zwecken. Vierteljahrsschr. f. prakt. Heilk., 1850, vii, 39 to 44. Nicolai, J. A. H.: Beschreibung der Knochen des menschlichen Foetus. Regensberg, 70 pp. 1829. Nomballais, J. M. E.: Contribution à l'étude de l'ossification des os du carpe d'apres la radiographie. Thèse, Bordeaux, 36 pp. 1909. Olivier, C. P.: Annales d'Hygiéne publique, xxviii, 342. Pleissner, H.: Nonnulla de ossificatione in femoris inferiore epiphyse. Diss. Lipsiae, 22 pp. 1861. Pozier, J.: Etude radiographique de l'ossification du genou chez le nouveau-né. Thèse, Paris. 1912. Pryor, J. W.: The chronology and order of ossification of the bones of the human carpus. Bull. of the State Univ., Lexington, Ky., 1908. Puyhaubert, A.: Recherches sur l'ossification des os des membres chez l'homme. Journ. de l'Anat. et Physiol., 1913, xlix, 224 to 268. Rambaud et Renault: Origine et développement des os. Paris, 1864. Rotch, T. M.: A Study of the Development of the Bones in Childhood by the Roentgen Method, with the View of Establishing a Development Index for the Grading of and the Protection of Early Life. Trans. Am. Physicians, 1909. Rotch, T. M.: A Comparison in Boys and Girls of the Same Height, Weight and Epiphyseal Development. Arch. Pediat., 1910, xxvi, 567 to 569. Sappey, M. P. C.: Traité d'anatomie descriptive. (Ed. 2), T. I. 1867. Tamassia, A.: Sul centro d'ossificazione dell'epifisi inferiore del femore, dell' astragalo e del calcagno. Atti R. Inst. Veneto di Sci. Lett. ed Arti, 1893, 7 ser., iv, 815 to 828. Toldt, C.: Die Knochen in gerichtsärztlicher Beziehung. In: Maschka: Handb. d. gerichtl. Med., Bd. iii, 483 to 585, 1882.

# THE ADMINISTRATION OF PITUITRIN AT THE BEGINNING OF THE THIRD STAGE OF LABOR*

## With a Report of One Hundred Cases

By Geo. H. Ryder, M.D., New York

THE third stage of labor has always been a matter of concern to the obstetrician. He knows that at any time during this period, hemorhage may occur. It may appear in any kind of labor, even in the easiest and apparently the most normal. And unless the obstetrician is prepared to meet and check this hemorrhage promptly, it may lead to most serious consequences. Aside from deep tears of the cervix, fibroids of the uterus, or abnormalities of the placenta such as placenta previa and accidental hemorrhages, hemorrhage occurring in the third stage of labor is due mostly to relaxation of the uterus. This relaxation is more apt to occur in a uterus exhausted by difficult or prolonged labor, but may occur in almost any kind of labor.

It is knowledge of this possibility of hemorrhage that makes the conscientious obstetrician apprehensive during the third stage of labor, and causes him to be on the alert, till the placenta is safely and completely expelled, and the uterus has firmly contracted, with no sign of bleeding. Even then the obstetrician cannot safely relax his vigilence, for it is possible that softening of the uterus may occur after labor, with consequent hemorrhage, unless measures are taken to guard against it.

Several methods are in use for preventing hemorrhage during the third stage of labor and for insuring the complete expulsion of the placenta.

1. The fundus is left entirely alone and untouched, and after a certain time, the placenta is expressed by Credé. This method is mentioned only to be condemned, for it seems too uncertain and haphazard. It is true that in many cases the uterus if left alone will behave perfectly, but it is also true that in many other cases it will not. Instead it will balloon up and partially fill with blood, and thus needless and even serious hemorrhage may occur.

2. The obstetrician looks after the fundus himself. Putting his hand on the patient's abdomen after birth of the baby, he locates the fundus through a sterile towel, and by holding it and gently tickling it with his finger tips when it starts to relax, he can keep it well contracted and prevent hemorrhage. Finally, at the appropriate time, usually in from ten to twenty minutes, he can cause the expulsion of the pla-

*Read at a stated meeting of the New York Academy of Medicine, January 20, 1921.

centa by using Credé's maneuver. Some fundi are harder to control than others, but usually there is little difficulty in following this method.

Unfortunately, the obstetrician cannot often use this method, for the newborn child claims his attention. He must see that it cries well. He must tie and cut and dress the cord and attend to the baby's eyes. These duties may be delegated to an assistant, but they are of so great importance that the obstetrician usually feels obligated to attend to them himself. Therefore, the third method is more often used.

3. The obstetrician feels the fundus from time to time, as he is able, through a sterile towel, and for the rest of the time, until he has attended to the baby, he intrusts the care of the uterus to a nurse or an assistant.

This method is not entirely satisfactory, for it is an unfortunate fact that very few nurses know how to hold a fundus in the third stage of labor. And even of the doctors themselves many are almost equally ignorant. So that unless an assistant is especially trained in obstetrics his help is not much more valuable than that of the nurse. To me it is one of the greatest comforts to have an assistant who knows how to hold a fundus skillfully. Such an assistant is not always available, and the obstetrician is thus obliged to depend on the nurse.

Except for a few, who have had unusual experience, practically all nurses show the following faults when trying to hold the fundus.

They fail to locate the fundus at all, and spend their time holding on to, or actively massaging the patient's abdominal wall, while the fundus is riding above their hand entirely untouched. Or, if they do locate the fundus at first, they lose it as soon as it softens and relaxes, a time when it especially needs attention to prevent hemorrhage. Again, when the fundus is hard and well contracted, it is easy to feel, and then in spite of being cautioned, they persist in vigorously rubbing and prodding it. This tends to cause premature and incomplete separation of the placenta with bleeding. Thus they fail to stimulate the softening fundus, and they overstimulate the hard,, well contracted fundus. All this tends to produce unnecessary hemorrhage.

4. The use of ergot in the third stage of labor. This seems to be of little advantage and even dangerous. In the first place, ergot is slow in action, usually not before twenty or thirty minutes, by which time the third stage is often over. In the second place, ergot causes a tonic or continuous contraction of the uterine muscle, so that if it happens to act before the placenta is expelled, the uterus may clamp down tight on it, holding it imprisoned, and making its expulsion difficult, even forming the dreaded hour-glass contraction.

It is a safe rule that ergot should never be used until the uterus is empty.

5. The use of pituitrin, pituitary extract, or infundibulum, as it is

variously called, in the third stage of labor. This drug in small doses seems to act on the uterus to produce not tonic contraction as does ergot, but clonic contraction, contraction followed by relaxation. Thus it may be safely used, unlike ergot, on a uterus which is not empty. Moreover, its action is much more rapid than that of ergot. When given hypodermatically it usually acts in from two to seven minutes, but continues its action only twenty or thirty minutes.

For years it has been my routine to have a hypodermic syringe filled with 1 c.c. of pituitrin, ready during the third stage of labor. On the first sign of undue hemorrhage or relaxation of the uterus, this dose is given hypodermatically, and shortly after when the uterus is felt to contract firmly, the placenta is expressed by Credé's maneuver. Usually, this is quite easily accomplished. If the third stage is normal, the pituitrin is given immediately after the complete expulsion of the placenta. This is followed by a dram of ergotole by mouth. The idea is that the pituitrin causes a quick contraction of the uterus, and as its action begins to wear off in about twenty or thirty minutes, that of the ergot begins and continues. This method has proved quite satisfactory. However, it does not do away with the necessity of having the fundus constantly watched during the third stage by a nurse or doctor.

Many observers have reported good results from the administration of pituitrin at the beginning of the third stage of labor, as a routine, claiming that the management of this stage was thus made easier, and the satisfactory expulsion of the placenta was made surer.

With a view to testing this method, it was tried on one hundred ward patients at the Sloane Hospital for Women this summer. This was with the permission of Dr. Caldwell, in charge of the summer service, and of Dr. Studdiford, Director of Obstetrics in the Hospital. The work was done under the direct supervision of Dr. Caverly, one of the Assistant Resident Obstetricians, and with the help of the Interne Staff.

Irrespective of the kind of labor, or of the condition of the patient, each woman at the beginning of the third stage was given 1 c.c. of Burroughs Wellcome preparation of pituitrin by hypodermic injection. The fundus was then held for twenty minutes by student, doctor, or nurse, unless the placenta was expelled spontaneously before that time. No attempt was made to express it sooner than this, however. If the fundus showed signs of softening unduly, it was gently stimulated.

Of these 100 cases then, all had 1 c.c. of pituitrin at the beginning of the third stage.

Eighty-six were normal vertex deliveries; 8 were forceps deliveries; 5 were breech deliveries; and one was a multiple birth, twins.

Eighty had no medication (pituitrin or ergot) after labor, and showed no need of it.

Twenty had either pituitrin or ergot after labor, because they *did* show need of it.

In 25 the placenta was expelled spontaneously before 20 minutes.

In 75 it was expressed by Credé at the end of 20 minutes; in 74 with slight pressure; and in 1 with strong pressure, at the end of 60 minutes under ether, after three unsuccessful attempts previously without ether.

All of the 100 placentæ came away complete. None needed manual extraction.

The average time of placental delivery was 18.2 minutes. The shortest time was 5 minutes spontaneous. The longest was 60 minutes by Credé under ether, being the only delivery delayed over 20 minutes. The time of delivery is partly arbitrary, however. For a deliberate attempt was always made to wait 20 minutes. In many the placentæ could seemingly have been expressed in less time easily.

There was no hemorrhage of the first degree, that is of 16 ounces, or over. The average amount was estimated at 5.9 ounces.

After labor the fundus was observed to remain hard in 93 of the 100 cases for one hour; in 6 it hardened and softened alternately during that time; and in 1 it remained soft persistently till pituitrin and ergot were given.

In the 19 other cases where pituitrin or ergot was given postpartum, it was given for slight bleeding only.

Seventy-four of the 100 cases during the puerperium had no temperature at any time of 100° F. or over; 26 *did* have temperature at some time of 100° F. or over, 16 of these due probably to uterine causes, and the rest to causes entirely outside of the birth canal.

For comparison with this series of 100 cases, which we may call the pituitrin series, 100 other labors were observed in which pituitrin was *not* given at the beginning of the third stage of labor.

Eighty-eight of these were normal vertex deliveries; 8 were forceps deliveries; and 4 were breech deliveries.

Forty-five needed pituitrin or ergot postpartum, as against 20 in the pituitrin series.

None of the placentæ were expelled spontaneously, as against 25 in the pituitrin series.

Ninety-eight placentæ were expressed by Credé easily, as against 74 easily and 1 with difficulty in the pituitrin series.

Two placentæ were extracted manually, both after 60 minutes and after three attempts at Credé without ether and one with ether; none needed manual extraction in the pituitrin series.

The length of the third stage of labor averaged 17.5 minutes, as against 18.2 minutes in the pituitrin series. This observation is of

little value, as in the pituitrin series a deliberate attempt was made to wait 20 minutes, while in the nonpituitrin series no such attempt was made. However, this effort to express the placenta before 20 minutes, gave less chance of its spontaneous expulsion, and might partly account also for the greater hemorrhage in the nonpituitrin series.

The hemorrhage was slightly greater in the nonpituitrin series, an average of 8.2 ounces, as against 5.9 ounces in the pituitrin series.

In the puerperium 60 had no temperature at any time of 100° F. or over, as against 74 in the pituitrin series; and 40 did have temperatures at some time of 100° F. or over, as against 26 in the pituitrin series; 36 of these were due possibly to uterine causes, as against 16 in the pituitrin series.

Following this series, the writer tried the administration of pituitrin at the beginning of the third stage of labor, on 7 of his own private patients.

Six were multiparæ, all with normal vertex deliveries, all with short labors, one of 8 hours and the others all under 5 hours each. One was a primipara, with a forceps delivery and a 10½ hour labor.

The length of the third stage was 26 minutes, 23 minutes, and 15 minutes, respectively, for 3; and 20 minutes for each of the others.

The amount of hemorrhage was as follows: 2 had 10 ounces each; 2 had 8 ounces each; 2 had 6 ounces each; and 1 had 7 ounces. An average of 7.8 ounces.

In the first 5 the fundus contracted promptly within five minutes after giving the pituitrin, and remained so, without tendency to soften or enlarge. At the end of fifteen or twenty minutes, with slight pressure on the fundus, the placenta was expressed easily, and complete. In one of these cases the cervix shut down on the trailing-after membranes, but with a little delay they came away complete.

In the last two, when the placenta was expressed, clots were inside of the membranes. In one there was a hard clot weighing about 8 ounces. There was practically no other bleeding before or after expulsion of the placenta. In the other, with the birth of the placenta, about 8 ounces of bright clotted blood was found in the membranes, and further pressure on the fundus expressed 2 more ounces of clots. In this case, the fundus remained hard throughout the third stage, but was rather high, and the bleeding seemed to be into the membranes already partly expelled into the vagina. It seems probable that in each of these two cases earlier expression of the placenta might have prevented this hemorrhage.

All of these seven cases received as a routine 1 dram of ergotole after labor.

## CONCLUSIONS

The series is too small to allow of definite deductions, but in so far as it goes, we may draw the following conclusions concerning the

administration of pituitrin at the beginning of the third stage of labor.

1. It is a safe procedure. In none of the 100 cases was there any bad effect apparent.

2. It tends to cause spontaneous expulsion of the placenta. This occurred in 25 of the 100 ward cases; in none of the private cases.

3. It tends to lessen the amount of blood lost. The average amount of hemorrhage per patient was $2\frac{1}{3}$ ounces less in the pituitrin series than in the nonpituitrin series. (For the 100 patients a total saving of nearly 2 gallons of blood!)

4. It makes guarding of the fundus during the third stage easier. Little stimulation of the fundus is necessary to keep it contracted.

5. It does not do away with the necessity of watching or holding the fundus. It is not sufficient that the fundus remains well contracted. It must be kept from riding high, otherwise unobserved bleeding may occur into the membranes already partly expelled into the vagina.

6. It is probably better not to wait twenty minutes as a routine before trying to express the placenta, as was done in this series. The attempt can often be made earlier with advantage, but should not be persisted in if expression is at all difficult.

7. The method is worthy of further study and consideration.

However, whether pituitrin is given at the beginning of the third stage of labor, or later, or not at all, it has been shown to be an efficient means of quickly checking hemorrhage. And, therefore, it should be at hand, in a hypodermic syringe, ready for instant use, during and after the third stage of every labor. This should be a part of the equipment of every modern obstetrician.

45 West Fiftieth Street.

(*For discussion see page* 84.)

# THE LEAST COMMON MULTIPLE IN OBSTETRICS*

By Herbert M. Little, M.D., Montreal, Quebec

TO THE obstetrician and the practitioner interested in obstetrics nothing is more surprising than the attention paid by the general public to anything which tends to the abnormal in the management of what should be a natural process. Extensive advertisement, for example, of twilight sleep or other painless methods of childbirth go together with the remarkable attention attracted by labor as conducted in Rochester or Chicago. Yet the reason for this is not especially remarkable when we consider that the childbearing population, particularly that portion of it which by leisure is enabled to take interest in various social duties and indulge the common fondness for current fiction, may view these incidents as depicted by that friend of idle hours—the modern novelist. A later generation than readers of Tolstoi and Zola may take up the works of such novelists as Stephen McKenna, W. L. George, or John Galsworthy, and be struck by the peculiar ideas of these men regarding childbirth or perhaps by their ignorance of the work of the average obstetrician. For example, in "Sonia," O'Rane starts with a special halo of romance because his mother died giving him birth. In "Caliban" the whole life history of the hero is to a certain extent altered and his domestic arrangements completely upset because the long awaited child died during or just after its birth. True, these are more or less minor instances, but in "In Chancery," Galsworthy's latest book, we have the same old story of the husband tortured by the necessity for decision as to whether the mother or the child shall be saved—the same old dictum that another child would kill the mother: "If I don't operate, the baby will be born alive. It's a great risk for the mother." If these are not sufficiently classic, it may be well to remember the death of Mrs. Farfrae in Thomas Hardy's "Mayor of Castorbridge"—a fright, premature labor, and sudden death. If you object that these are English views, one may refer to Lewis's "Main Street," that much discussed American novel, in which the process of having children is depicted in a way anything but cheerful.

Now, if we take these views as those ordinarily accepted by the laity, it may be suggested that the average woman enters upon pregnancy not only with a dread of the outcome for herself and baby, but with the practical assurance that, even should both survive, the ordeal will be a terrible one. Is this point of view justifiable? At this very minute I have before me pamphlets of the Metropolitan Life Insur-

*Read at a stated meeting of the New York Academy of Medicine, January 20, 1921.

ance Society of this city, noting the remarkable increase in maternal death during labor and asking for comment thereon.

Is it not time that we should take counsel together, with a view to improving our work, if at all possible, and placing before the public the results of the proper handling of maternity cases, the infrequency of maternal death, and the relative unimportance of childbirth as a cause of maternal death, when there has been sufficient prenatal care?

My warrant for bringing this matter before this Academy is not only the satisfactory record of the Montreal Maternity in these matters, but the debt that we feel we owe to the obstetricians of New York in placing in the hands of the profession methods tending to greater simplicity in treatment, which have resulted in a remarkable improvement in our results.

The lengthy participation in war has accounted for a marked decrease in the amount of constructive work in the various departments of medicine, but at the same time has resulted in an almost complete readjustment of methods in some departments, for two reasons: (1) the exaggerated cost of many medicines and chemicals, notably alcohol; and (2) the appreciation of the fact that, during the war, success in treatment depended upon simplicity and immediate employment, rather than on undue complication. The methods in use in the Montreal Maternity today are simpler than at any time since that institution was opened, and the results are, so far as I can classify them, better than at any period since that date.

That this should be so in the department of obstetrics is very gratifying for the reason that, though trained in a school which prided itself on giving students instruction which would make them competent obstetricians wherever that specialty was called into play, I heard during my postgraduate days nothing but the plea that there was house obstetrics as opposed to hospital obstetrics, and that a man might be a competent hospital obstetrician only if qualified to undertake treatment which would not be adapted to household use. It is obvious that this point of view militated greatly against the satisfactory training of students in one of the most important branches of the profession, and it is gratifying to note that any changes made in the direction of simplicity have been measures adapted to everyday use by the general practitioner.

To a consideration of a simple routine the smallest possible combination of all that is best, the least common multiple of methods; I would ask your indulgence for a few moments. While dealing especially with factors involved in the conduct of labor and in the puerperium it will perhaps be more satisfactory to consider as well the management of pregnancy.

Maternity is a test of function, and pregnancy should be a perfectly normal state for a normal woman. Beyond the injunction to drink

plenty of water, to be sure that there is a daily evacuation of the bowel, and to massage the nipples in order to facilitate nursing, little advice is necessary. Apart from the relatively frequent examination of the urine, in which the two most important factors are the presence of albumin and the appearance of pus cells, we believe that the best thing to do is to let the patient alone as much as possible until within the last month. Why they should not ride, golf, or swim, I have never been able to understand, and, apart from being told to be careful at such times as menstruation would take place, were they not pregnant, they are allowed every freedom.

The three chief complications of pregnancy from the practitioner's point of view, are, of course, vomiting, toxemia, and pyelitis.

### VOMITING

Following the experimental work of Dr. Whitridge Williams and of Ewing and Stone, a great deal was written about the pernicious vomiting of pregnancy. My own belief is that clinically there is no such entity. That to severe vomiting early in pregnancy there are sometimes added the toxic results of acute starvation is not remarkable, but in twenty years I have seen no more than five cases where the emptying of the uterus was necessary or justifiable, and, though the most recent is now some years gone by, I am not certain that even this, had it been treated from the start of the pregnancy, would have required the termination of the pregnancy.

Two recent theories regarding morning sickness are (1) a possible ovarian insufficiency; and (2) an alteration in the circulation of the brain when the patient assumes an upright position. As said before, the onset of toxic symptoms with the vomiting implies starvation. The prevention of starvation is therefore the object of any treatment. We have found that, even where vomiting had assumed rather serious proportions, it has always been possible to prevent starvation by the administration of such foods as are not easily vomited; and a great many patients have found early relief when placed on a diet of nuts, raisins, and milk chocolate, substances which can be carried easily in the pocket and taken in place of regular meals.

Years ago a sailor suggested to me as preventive treatment for seasickness the wearing of a tight band about the neck and eating dry stuffs which were not easily rejected. Both of these suggestions I have had occasion to put into practice with the most satisfactory effect, and only recently, after hearing a dissertation on the postural factor in morning sickness, the sound nature of the physiology of the treatment impressed itself upon me, notably the passive congestion induced by a band about the neck before the patient left her bed. Both of these measures have given remarkably good results. It may be objected that they are simply methods of suggestion. Perhaps so.

The addition of hypodermic injections of corpus luteum extract can do no harm and has a therapeutic basis.

### PYELITIS

Among the complications of pregnancy pyelitis has become much more prominent than formerly. Whether from being more readily recognized or not, the fact remains that we have had in the hospital in the past year as many of these cases as would formerly have been admitted in five years. The surprising thing is that so few are recognized outside the hospital. One reason for this would appear to be the frequent absence of pus from the urine at the time of maximum severity of symptoms. An irregular typhoid-like temperature with indeed few definite symptoms apart from malaise and practically no signs other than the characteristic pain elicited by pressure in the right costovertebral angle and possibly a few pus cells in the urine, may be associated with a very extensive infection of the upper urinary tract. In a number of these cases, in which the ureters were catheterized, the obstruction to the ureter was found very slightly above its opening into the bladder, and was apparently due to the well recognized torsion of the uterus. The occasional appearance of blood in the urine after even the most careful catheterization has led us to avoid catheterization wherever possible, and by posture of the patient and large doses of urotropin, together with forced fluids, to carry her through to term, or, if in spite of treatment the condition becomes aggravated and there are recurring chills, to have no hesitation in emptying the uterus, preferably by vaginal section.

### NEPHRITIS

We have been able to do very little with nephritic toxemia. Personally I do not believe that eclampsia often occurs without definite prodromal symptoms, but those cases of pregnancy in a patient with a latent nephritis, often the result of scarlet fever, offer great difficulty, and my own impression is that the first pregnancy is usually the only one which offers any possibility of successful termination. By careful watching, it should be possible to determine time for induction of labor before the destruction of the placenta by infarction, but sudden death of the child by an accidental hemorrhage, another complication of such toxemias, is almost impossible to foretell. There can be no doubt that the effect of a pregnancy on a damaged kidney is to damage that organ still further, and, while I have seen repeated attempts to secure a live child, I have never yet seen one that was successful. In neither of these cases, however, is it a question of immediate life or death for the mother.

## LABOR

In discussing the management of labor, the pelvis is, of course, a most important factor, but the present division of pelves into normal and contracted leads, I believe, to many unnecessary difficulties. Might I suggest that pelves, even when normal, may be disproportionate, and that so-called contracted pelves are only an obstruction to labor if disproportionate to the size and shape of the child which is to pass through the canal. Exact pelvimetry is not a substitute for antepartum examination of presentation and position and careful watching of the patient in the second stage. This has been brought home to us very forcibly in certain instances, where the pelvic measurements were apparently absolutely normal and yet there was extreme difficulty in birth, owing to the large size of the child, which had evidently gone beyond term. So too in pelves with contracted outlets. I have seen a number of cases where a cesarean section was done on account of the close approximation of the tuberosities of the ischium, but I have seen but one case where the contraction of the pelvic outlet offered resistance to the passage of the head when a test of labor was given. It is perfectly true that, when the bi-ischial diameter falls below 8.5 cm., the birth will be abnormal. Here, the biparietal diameter of an average head must lie behind the bi-ischial line; and, if a forceps is applied, the entire instrument must lie posterior to the attachments of the transversus perineii muscle. A realization of the danger of extensive damage to the soft parts, together with the relative certainty that the head can pass the pelvis, indicates either deep episiotomy as a preliminary to a spontaneous birth of the head or the application of forceps, with the distinct understanding that a laceration involving the rectum is almost inevitable. The ability to repair satisfactorily such laceration, however extensive, is, I believe, the hall mark of a competent obstetrician.

The question of operative interference during labor is a very broad one and may be viewed from many angles. My own belief is that the obstetric history of any woman depends directly upon the management of the first labor, and that in cases of moderate disproportion, overstretching of the abdominal muscles in a prolonged second stage is an extremely important factor in the production of dystocia in later labors. I do not believe that version,—admirable operation that it is,—is desirable in a primipara, and in a multipara I believe it is always attended with the grave risk of extensive laceration of the cervix. On the other hand, when the head is arrested in the pelvis and the force exerted by the abdominal muscles seems insufficient to cause the head to advance, my suggestion would be that operation should be performed when it is believed that the moment has arrived when the *reparable* damage that may result from the operation is less than that which will result from allowing the labor to proceed normally. And

I would again insist that the gravest danger in the labor of any primipara is an overstretching of the recti muscles with resultant increased dystocia in subsequent labors.

To consider now the more important features in connection with the management of labor, it may be remembered that the causes of death are most closely associated with two complications, infection and hemorrhage. The frequency of puerperal infection can only be gauged by general morbidity statistics, and it is because, as I have previously said, our morbidity statistics have improved so markedly in the last few years, that I wish to bring before you tonight three factors in the management of labor: (1) rectal examination; (2) median episiotomy; and (3) absolute discontinuance of any medication after the delivery of the child. Rectal examination you know; median episiotomy Pomeroy has made known to you; and the discontinuance of purgation has been advocated by Ross McPherson and others, but to this we have added a further simplification—the discontinuance of such an old stand-by as ergot. These three measures are not important in themselves alone, but in their effect upon the general conduct of labor. For example, a patient who is not to have a purgative during the puerperium, receives on admission to hospital a dose of castor oil and an enema. The enema is not given to facilitate the passage of the head into the pelvis, as was the old idea, but to empty the bowel more or less completely. The median episiotomy allows an easy repair, and the repair can be done while waiting for the separation of the placenta. The nonmassage of the uterus allows a more regular and uniform contraction than where it is held or massaged. As a result the placenta separates more easily and there is no tendency, by forcing the organ with the membranes protruding from the cervix into the vagina, to smear the organisms from the posterior fornix and vagina over the cervix when the placenta eventually separates. The tying of the sutures of the episiotomy is an extremely easy matter. The placenta is allowed only time to separate, the patient regaining consciousness and expelling it by her own efforts. The sutures are then tied and the fundus watched. It is true that a certain amount of clot may form in the cavity, but at the end of half an hour this is expressed, and, as by that time the formation of thrombi at the placental site has taken place, the patient is secured from further danger from this variety of concealed hemorrhage.

In the instruction of students nothing is more satisfactory than the unusual facility that men gain in making obstetric diagnoses, when started properly and allowed a certain amount of latitude in making examinations. So far as the conduct of labor is concerned, this, I believe, is the most important of all teaching, for a knowledge of the presentation and position of the child's head, gained by external examination, implies the relation of the head to the pelvis,—and the

only other element in the estimation of the course of labor is the amount of dilatation obtained by the patient's pains. For ten years I personally have made no vaginal examinations except in operative cases, and, save for the practice of gaining familiarity with a cervix previously palpated through the rectum, none of the internes in the hospital make vaginal examinations. The student makes first an external examination and palpates the cervix per rectum. He then scrubs up and makes a vaginal examination, and lastly checks up these two examinations by a further rectal examination. It is surprising how quickly the men learn to determine (1) the amount of dilatation of the cervix; and (2) the position of the head in the pelvis.

It is obvious that in this way the number of contact infections must be materially diminished, but even with rectal examinations we have had occasional trouble with perineums which have not healed properly and mild infections which have appeared in the second week. The patients most free from these mild complications have been those who have undergone severe operations, for example the repair of complete tears in the rectum, in which event they are kept absolutely at rest and no purgative given. Whether or not purgation has an effect on the normal course of such cases, it is difficult to say, but there is no doubt that these cases did better than others which were handled less.

In my own work median episiotomy has been a practice for some ten years. I have, however, to thank Dr. Pomeroy's advocacy of the measure for the ability to teach it as well as practice it. With the introduction of this measure by Dr. Pomeroy, more and more cases have come into the afebrile and uncomplicated class. For this I think there are two reasons: (1) the tissues about the perineum are far less damaged; and (2) since the introduction of this method there is less anesthesia and better control of the uterus, and less tendency to interfere with the uterus during the third stage. After the birth of the child, when a median episiotomy has been done, the anesthesia which is sufficient for the passage of the child through the vulva is usually sufficient for the introduction of a continuous submucous stitch in the vagina and a subcutaneous suture in the midline of the perineum, and one or two deep silkworm gut sutures to hold the deeper tissues together. If the uterus is let absolutely alone after the birth of the child, these sutures may be laid with the greatest possible ease. Even where the introduction is a matter of ten or fifteen minutes, there are those fifteen minutes when it is absolutely certain that there will be no manipulation of the fundus of the uterus, when the patient is gradually gaining consciousness, and with the first few pains after coming out of the anesthetic the placenta separates spontaneously and can be readily expressed. The tying of the sutures is then a matter of a moment.

For the past few months I have been watching carefully those cases

in which there has been a typical so-called sapremia;—a mild grade infection manifesting itself often only after the patient has been examined for discharge, thirteen or fourteen days after confinement. I have found invariably that such cases were those in which the placenta did not come away spontaneously, where more or less massage of the uterus had been done, and where naturally membranes trailing in the vagina had swept up into the uterine cavity the debris from the posterior fornix. Not only are the membranes accountable for this, but, where there has been undue prolongation of the second stage, the perineum being allowed to distend slowly and the muscles to rupture subcutaneously, the relaxation of the uterine muscles allows the collection within the uterus of large clots, which invariably give trouble.

Our procedure, therefore, is to leave the uterus absolutely alone until after the placenta has separated, then to watch it carefully, giving no ergot, and at the expiration of from half to three-quarters of an hour to express from the uterus such clots as may have formed within the cavity, with the assurance that their re-formation is most unlikely.

A further feature is the relation of the bladder to the third stage. If the labor has been at all prolonged, the bladder will probably be distended. A distended bladder prevents proper contraction of the uterus and has, I believe, a mechanical effect in preventing the proper closing of the larger sinuses, mechanically favoring the extension of thrombi in the lower broad ligament. If then the emptying of the bladder is made a matter of routine with the laying of the sutures, not only will there be better contraction of the uterus, but the possibility of later catheterization is greatly minimized.

So far as the clinical management of routine cases is concerned, nothing has given us more satisfaction than the application of that method of treatment advocated by Dr. Ross McPherson. Even before the war I had collected a large number of cases showing the apparent beneficial results so far as temperature was concerned of the nonadministration of drastic purgatives during the puerperium. The results obtained were so similar to those detailed by Dr. McPherson that recently the routine order of castor oil has been discontinued, and patients are given a purgative only when they request it themselves. There have been many discussions over the cause of irregularity in temperature when purgatives are administered, but no definite solution has been offered. The fact remains that patients who do not have purgatives run a much smoother clinical course. To those in charge of clinics I would say, try this method if for no other reason than the lessening of the amount of care required by the normal case and the resulting increased time of the nurses for the care of those patients who are seriously ill.

Much anxiety would be relieved if we could impress upon obstetri-

cians that postpartum hemorrhage is not a condition but merely a physical sign, either of serious damage to some portion of the birth canal, usually the cervix, or of improper closure of the uterine sinuses. The question of damage to the cervix is to my mind negligible, except in certain cases of version, where there is always danger in the reduction of the arms. The factors preventing proper closure of the uterine sinuses are not numerous. The importance of the bladder as a preventive of proper contraction is usually much underestimated, while the failure of the uterus itself to contract is usually the result of overdistention, overwork, prolonged anesthesia, or incomplete expulsion of its content. The tendency to hemorrhage after hydramnios, twins, or protracted pregnancy is well known, and should be specially discounted in the management of the third stage. Two other factors—retention of portions of the placenta and bleeding from improper or partial separation of the placenta, both I believe associated with a too active management of the third stage,—have been more or less eliminated for us in primiparas since the introduction of the Pomeroy treatment of the perineum. The facility of repair of incised wounds without additional anesthesia, the importance of laying the sutures during the second stage in a clear field, undisturbed by hemorrhage from the uterus, has increased the necessity for caution against manipulation of the uterus as soon as the child was born, and resulted in spontaneous expulsion of the placenta on recovery from the usually short and light anesthesia, and there has been markedly less tendency to hemorrhage.

In the last five years, in some thousands of cases passing through the Montreal Maternity, we have had not more than five breast abscesses, and none of these were in the public service. For this satisfactory condition of affairs I believe two factors are responsible: (1) the abolition of breast pumps; and (2) the discontinuance of any special treatment of the nipples other than care for cleanliness. In every instance where I have seen a definite purulent mastitis in consultation, I have made a point of investigating the previous history, and have been struck by the number of instances in which the breasts had been pumped in a previous pregnancy. To the mushrooming of the nipple, caused by the excessive suction of the pump, with a consequent opening of the ducts to extraneous material such as epithelium or dust, may be attributed a large percentage of blocked ducts, while the careless application of ointments for nipple protection acts very much in the same way. I do not deny that fissuring of the nipples is a comparatively frequent occurrence, but for this condition the application of the ordinary silver nitrate used for babies' eyes is almost specific. Occasionally too there may be definite collections of fluid in the breast, which for the surgeon have all the earmarks of distinct abscess, but massage toward the nipple will almost invariably free the

duct, and putting the affected breast at rest for 24 hours will effectively prevent the breaking of the capsule surrounding the breast tissue and the involvement of the fatty tissue of the breast. Not infrequently patients complain of pain in the breast, and there is a fluctuating mass and often a high temperature. In these cases a piece of white absorbent is the indicator. The ordinary milk will not stain the cotton, but the content of the distended sac invariably shows as a dirty greenish yellow. That this abnormal content contains bacteria is known, and those interested are referred to a very complete résumé of the subject by John F. Gardner of Toledo.

For the furthering of involution, hot vaginal douches of formalin are given on the ninth day. I have never known these to do harm. Intrauterine douches, on the contrary, I believe, do harm. In my own experience I have never had occasion to give an intrauterine douche immediately after labor, but I have used them not infrequently on the 14th day. The surprising thing about these late douches is the evidence they give of the rapidity of absorption from the uterus. Where there has been mild infection and rather profuse lochia, and a boggy uterus at the examination for discharge, irrigation will frequently be accompanied by a chill and rise in both temperature and pulse, but this is only temporary. On the other hand, where there has been no temperature and where the delayed involution has been due to retained membranes, which I believe may be retained without becoming infected, the irrigation of such a cavity gives rise to a rapidity of the pulse without any marked rise in temperature. This, too, is transitory.

### TREATMENT OF THE CORD

The treatment of the cord is emphatically to let it alone. In the pre-prohibition days, we like many others applied alcohol for the purpose of dehydration. Recently the difficulty in securing alcohol led us to experiment with a plain dry dressing, and the results have been more than satisfactory—in fact better than when alcohol was used.

285 STANLEY STREET.

(*For discussion see page* 84.)

# EXPERIMENTAL STUDIES FOLLOWING OÖPHORECTOMY*

By Harold Bailey, M.D., New York, N. Y.

THE conservation of the ovaries or of that portion of them that is not diseased is one of the aims of modern gynecology. This principle is applied, not only to disease of these organs, but especially in cases of fibromyoma where the uterus is to be removed. At this time, when so many cases of myopathic hemorrhage and fibroid uteri are treated by radiation from radium or roentgen rays, with the result that the ovaries become sclerotic and the artificial menopause is produced, a discussion of the desirability of retaining active ovaries is advisable.

The Brown-Séquard hypothesis that the ductless glands provide an internal secretion seems, at first glance, easy of proof, concerning the sex glands and especially the ovaries. The sequelæ, following the removal of these organs, are so well known that even the lay public readily accepts the plausibility of the theory that they produce a substance which gains access to the circulation and directly affects the body cells either through a specific reaction or by interaction with other endocrines.

Even in ancient time oöphorectomy was made use of in the horse and also in domestic animals as a preparation for their appearance on the market as food. In the young before puberty castration not only leads to an increase of fat, but also to an increase of the bodily frame amounting even to giantism. The sexual organs and the secondary sexual attributes do not develop and there is marked mental lethargy. At the time of the natural menopause there is tendency toward adiposity and a less energetic physical life. During pregnancy owing to the growth of the corpus luteum there exists a similarity to the climacteric period. There is deposition of fat and a considerable growth of the body that is far above any need of the fetus.

However, some of these facts are more apparent than real. That there is regularly an increase in weight at the menopause may be denied. Tilt[1] found a gain in only 43 per cent of 282 women following the natural menopause and Glaeveke[2] noticed a gain not above 25 pounds in 66 per cent of women having an artificial menopause. Jayle[3] found that in 13 women who had the uterus removed together with the ovaries 5 gained in weight; but of 14 cases where the uterus alone was removed there were 3 who gained. Of course, cases that have been suffering from tumor or inflammation and seek operative relief cannot be considered in good health and may be underweight.

---

*Read at a meeting of the Section on Obstetrics and Gynecology of the New York Academy of Medicine, December 28, 1920.

Fehling[4] was the first to apply the suggestion of the existence of general bodily effect from the ovaries, when he argued for their removal in cases of osteomalacia. While other explanations have been made accounting for the results in such a procedure,[5] it is a fact that Senator[6] in 1897 was able to show an increase in the output of calcium and magnesium and alloxuric acid after the administration of ovarian extract to a patient suffering from this disease.

### STUDIES IN METABOLISM

In an endeavor to determine the effect of the ovaries on metabolism and thus provide a scientific basis for Fehling's contention, Curatelo and Tarulli[7] conducted experiments with animals following oöphorectomy. They used a Voit apparatus and were able to show in one animal 34 per cent reduction in the carbon dioxide excretion following the operation. This animal also gained 17 per cent in its weight. There was a diminution in the phosphorus loss.

Loewy and Richter[8] in 1899 removed the ovaries of a dog and determined the metabolism by the Zuntz-Geppert principle. Following the operation there was an almost immediate gain in weight and a considerable diminution of the oxygen consumed even at the end of three weeks. At the end of six months there was a decided loss, the oxygen per kg. minute sinking from 6.1 c.c. to 4.8 c.c. After the administration of oöphorin tablets there was a gain of 67 per cent in the oxygen consumption with a rapid return to the new low level on discontinuance of the feeding. The authors warn against a general deduction being made from the result in this one animal and Zuntz, in whose laboratory the work was done, four years later examined the same dog and was able to obtain only a 6 per cent rise with fresh oöphorin tablets. He suggested that the results in this animal might be in the nature of an idiosyncrasy. It would appear, however, that the control after the dog was well advanced in its artificial menopause could not be considered as discrediting the earlier work.

In 1899, Hugo Luthje,[9] using the Voit respiration apparatus for 24 hour periods, undertook to control these experiments and adopted a most unique procedure. A male and female dog from the same litter were castrated, two other members of the same litter and of corresponding sex were used as controls. The male animal showed no difference. The female gained slightly in weight, but as it was on a regular diet and appeared in general more robust, this gain was discounted. Five months after the oöphorectomy the carbon dioxide excretion was 1.049 c.c. and the control 1.056 c.c. The nitrogen and phosphorus excretion showed but slight differences. This author came to the conclusion that the sex glands have no specific effect on the metabolism and offered the suggestion that the gain in weight in women at the menopause was not due to the specific ovarian influence, but rather to the change in the life and habits of the individual.

As these results were so strikingly opposed, Murlin and Bailey,[10] in 1917 attempted to settle the question. Two female dogs were castrated and one of them had had also a thyroidectomy. Their metabolism was estimated by the indirect method, using a constant temperature respiration incubator. In addition to the general control of the observation periods the urine was analyzed for nitrogen and the amount included in the figuring. Both animals gained about 900 grams and in the first there was a reduction in the metabolism of 17.5 per cent and in the other of 14.2 per cent. As these animals were not of the same breed and there was a difference of 2.5 kg. in their weight it is remarkable that these figures are so close. As fat takes no active part in the metabolism, their increase in weight may be disregarded, but even then there is a reduction of 12 per cent in one and of 6 per cent in the other. They were fed, perhaps, somewhat beyond their needs and they became less active following the operation. They also became familiar with their surroundings and ceased to fear when placed in the incubator. It appeared to us that these factors were worthy of consideration. It was believed that the dog without the thyroid would suffer a greater reduction than its fellow but the reverse was the case. In the one instance, therefore, there was no evidence of compensatory work on the part of the thyroid after the oöphorectomy.

The experimental evidence, in animals, of a direct effect of an ovarian secretion on the metabolism of the cell is not convincing but certainly points in that direction.

The only application of these principles to women was made by Zuntz[11] in 1904. He examined the metabolism before and after the removal of the ovaries in four women who were suffering from gynecologic ailments. There was no change at the end of 3 to 6 weeks in three of them. Of three who were later examined (periods of 7 weeks to 1½ years) in two there was no change, but in one there was a considerable lowering. Zuntz explained this one instance by assuming that the so-called normal was unusually high as the patient at that time had pain and fever. He administered oöphorin tablets to three of the women and noticed no change. None of the women gained in weight.

## ANIMAL EXPERIMENTS DEMONSTRATING THE RELATIONSHIP BETWEEN THE UTERUS AND OVARY

There is considerable difficulty in making an attempt to apply these laboratory results, and there is even the possibility that they are not due to the removal of the ovaries but to the secondary atrophy of the uterus. Sokoloff[12] has shown by experiment in animals that there is an atrophy of the uterus that follows the ovarian removal by about three months. He ascribes this result as due to the cutting off of the nerve supply during operation. Hofmeier[13] who noticed the same result

in the human ascribes it to a diminished blood supply. Carmichael and Marshall[14] taking great pains not to injure either the vessels or nerves removed the ovaries from rabbits and noticed at the end of six months decided fibrotic changes in the uterus. Marshall and Jolly[15] showed that the same condition exists in rats following the removal, but that it may be prevented by ovarian transplantation.

There is considerable clinical evidence that removal of the uterus leads to ovarian atrophy. Löwenthal,[16] as early as 1884, suggested that the menstruation processes, especially as regards the periodic bleeding, were not due to the rupture of the follicle but to some active principle existing in the mucous membrane of the uterus which stimulates the ovary. Blair Bell[17] also suggested that an internal secretion from the uterus stimulates ovulation.

Bond[18] conducted some experiments with a view to ascertaining whether there was not a uterine secretion which affected the ovaries. He was able to demonstrate by ligating the tube and horn of the uterus that a secretion was present which was heavy with albumin and salt. He conducted one experiment in which the entire uterus was removed and found later that the ovaries were normal. He concluded that the absence of this secretion from the uterus permitted the tissues of the ovaries to hypertrophy.

Grammatikati[19] in 1889 removed the uterus of rabbits and three or four months later examined the ovaries and found no degeneration or atrophy. Carmichael and Marshall apparently not knowing of these earlier experiments removed the uterus from three young rabbits and a few months later noticed no changes in the ovaries. Similar experiments but leaving a portion of the cervix also caused no ovarian change. The same results were obtained when rats were used as the experimental animals.

On the other hand Mandel and Bürger[20] performed hysterectomies on rabbits and waited for periods of eight months to three years before examining the ovaries. They found congestive changes with cystic degeneration and came to the conclusion that they could not have been functioning in a normal manner. Burckhardt[21] and also Keitler[22] doing the same experiments and waiting a long time before looking for sign of ovarian atrophy came to the same conclusion as did Mandel and Bürger.

An analysis of these experiments shows that no ovarian changes are present three months after removing the uterus but that they do appear considerably later.

### CLINICAL EVIDENCE OF UTERINE OVARIAN RELATIONSHIP

The clinical data are exhaustive. Abel[23] in a review of cases of complete hysterectomy came to the conclusion that ovarian atrophy resulted and that the climacteric period proceeded as after oöphorectomy.

In cases that had a subtotal hysterectomy with some of the mucous membrane left, there were no menopausal symptoms and this led him to the conclusion that the ovaries in these cases remained normal. He stated his belief that the activity of the ovaries was dependent upon the uterus and at a discussion of this subject at the German Gynecological Congress in 1899, he was upheld by Zweifel[24] and others.

Mandel and Bürger[20] in an extensive study of the subject from the clinical standpoint reviewed the opinions expressed in this Congress and then detailed the results of 309 cases of complete hysterectomy with removal of the ovaries and of 96 cases with hysterectomy with one or both ovaries left *in situ*. Of those patients that had the ovarian removal 79.3 per cent showed symptoms of the artificial menopause and 48.5 per cent of these women had the signs almost immediately after the operation. These figures correspond with those of other authors, Mainzer[25] showing 71 per cent, Burckhardt[26] 85 per cent; and Werth[27] 87.5 per cent.

Of those cases that had one or both ovaries left *in situ* 67.7 per cent had signs of the artificial menopause and 30 per cent showed the changes at once. These results are in close accord with Werth's who had 62.9 per cent with menopausal symptoms under similar conditions.

In the first group of Mandel and Bürger's cases there were 58.3 per cent that gained in weight and in the second group 67 per cent. They noticed no changes in the general temperament that would favor the conservative rather than the radical operation. The follow-up on these women led to the same conclusion that Zweifel and Abel had expressed—that the ovaries atrophy following the total hysterectomy.

Alban Doran[28] reported the follow-up of 60 cases of hysterectomy. There were 6 cases in which both ovaries were saved and in three of these the menopause was prompt in appearing. There were 26 cases in which only one ovary was left and in 13 of these—50 per cent—the menopause was complete and immediate. There are three recent contributions in the American literature dealing with the relative value of the retained ovary. Vineberg (1915)[29] reviews the experimental work and detailed several cases of his own that were reoperated and showed degenerative changes in the ovaries, and expressed his belief that, as the statistics only revealed a 20 per cent lower frequency of climacteric signs in the conservative as compared with the radical procedure, it was as well to remove the ovaries in every case of hysterectomy.

Graves[30] found that the incidence of vasomotor changes as a sign of the climacteric period was 80 per cent in 233 cases of total ablation, and 81 per cent in 26 cases with one or both ovaries left *in situ*. He concludes that the retention of ovarian tissue after removal of the uterus is of no physiological value and that it may be of serious harm to the patient.

Polak[31] in 1918 reported the results of 73 cases of reoperation following hysterectomy with the conservation of one or both ovaries and came to the conclusion that the "Life history of the retained ovary is of short duration and the trophic influence of the diseased ovary has been overestimated."

### IMPLANTATION EXPERIMENTS

There are some experiments relating to implantation of the ovary which support very strongly the view that there is an interrelation between the uterus and the ovary and that one is inactive without the other. Marshall and Jolly's[15] implantation experiments in rats showed clearly that in the animals in which the ovary was transplanted into one of the kidneys or into the peritoneum, the uterus remained normal while in the controls the removal of the ovaries were regularly followed by well marked fibrosis or atrophy of the uterus. It is evident, therefore, that the interrelation exists on the one side, that is, the uterus depends upon some trophic influence from the ovary for its maintenance.

Perhaps the most conclusive results dealing with this relationship are obtained by autografting and heterografting of the ovaries. Tuffier[32] reported the results in 173 cases. Twenty-four of these were heterografting, or the transplanting of an ovary from one patient to another, and 84 were autografting, or the transplanting of an ovary or a portion of one from its normal situation to another. These cases followed a complete hysterectomy. Under these circumstances the graft takes and after several months increases in size, periodically, continuing to do so for two or three years. The patients derived no benefits in these cases.

There were 65 cases of autografting in patients in whom the uterus had not been removed. Three or four months elapse before the ovary becomes active and in the meantime the menopausal symptoms persist. As soon as menstruation returns the symptoms are relieved. Tuffier concludes that the monthly ovulation alone cannot prevent the climacteric distress and that the bleeding itself brings relief. The conclusion to be drawn from this work is that ovulation and internal secretion from the ovary are not the necessary factors and that the real cause of the symptoms lies in the lack of menstruation. One of his conclusions is that "Ovulation without menstruation is useless."

W. J. Mayo[33] in a recent article on the "Conservation of the Menstrual Function" states that the preservation of the reproductive function is of the first importance and argues in favor of myomectomy rather than hysterectomy in women below 45 years of age. He calls attention to the fact that radium has a certain field in the treatment of fibroids but does not believe that it should be elected in place of myomectomy in younger women because of the danger of permanently

incapacitating the ovaries. He says "It is probable that menstruation itself has some important endocrine function."

## CONCLUSIONS

Metabolism studies after oöphorectomy tend to show a reduction both of the oxygen consumed and the carbon dioxide eliminated. The greatest reduction occurs at a time some two or three months after the operation and when atrophic changes have probably occurred in the uterus. The experimental work, therefore, must be considered as inconclusive as regards the demonstration of a direct effect on the energy metabolism of the cell by an ovarian secretion.

Experiments conducted with a view of ascertaining the condition of the ovary after hysterectomy show that in young animals the ovarian development goes on in a normal manner. Work with adult animals would indicate that following hysterectomy no ovarian change may be demonstrated until after a three or four month period.

Clinical gynecology offers proof that the menopause ensues notwithstanding that the ovaries remain, if the uterus is entirely removed; and that saving a portion of the uterine mucous membrane so that menstruation may occur, prevents these symptoms.

Transplantation of the ovary is of no value in relieving menopausal symptoms, unless the uterus or part of it remains.

## BIBLIOGRAPHY

(1) Tilt, Edward John: A Handbook of Uterine Therapeutics, London, 1863. (2) Glaeveke: Arch. f. Gynäk., 1889, xxxv, 1-88. (3) Jayle, F.: Revue de Gynéc., 1897, i, 403-455. (4) Fehling, H.: Ztschr. f. Geburtsh. u Gynäk., 1894, xxx, 471-476. Arch. f. Gynäk., 1894, xlviii, 472-498. (5) Bailey, H. C.: Am. Jour. Obst., 1916, lxxiii, 1076. (6) Senator, H.: Berl. klin. Wchnschr., 1897, xxxiv, 109-112 and 143, 144. (7) Curatelo and Tarulli: Bull. del l'Acad. Med. di Roma, 22, 1895, 496. (8) Loewy and Richter: Arch. f. Anat. und Physiol., 1899, Supplement 174-198. (9) Lüthje, Hugo: Arch. Exper. Phth. and Pharm., 1902, xlviii, 185-222. (10) Murlin and Bailey: Trans. Am. Gynec. Soc., 1917, xlii, 247-256. (11) Zuntz, L.: Ztschr. f. Geburtsh. u. Gynäk., liii, 1904. (12) Sokoloff: Arch. f. Gynäk., 1896, lxxi, 286-302. (13) Hofmeier, M.: Ztsch. f. Geburtsh. u. Gynäk., 1880, v, 96-111. (14) Carmichael and Marshall: Proc. Royal Soc., 1907, lxxix, p. 387. (15) Marshall and Jolly: Trans. Royal Soc., Edin., 1907, xlv, p. 589. (16) Löwenthal, W.: Arch. f. Gynäk., 1884, xxiv, 169-261. (17) Bell, Blair: Liverpool Medica-Chirurgical Jour., 1906, p. 234. (18) Bond: Jour. Physiol., 1898, xxii, p. 296. (19) Grammatikati: Zentralb. f. Gynäk., 1889, vol. xiii, p. 105. (20) Mandel and Bürger: Die Biologische Bedeutung der Eierstöcke nach Entfernung der Gebärmutter, Leipzig, 1904. (21) Burckhardt, G.: Ztschr. f. Geburtsh. u. Gynäk., lviii, No. 1. (22) Keitler: Monatschr. f. Geburtsh. u. Gynäk., 1904, xx, pp. 687-753. (23) Abel, G.: Arch. f. Gynäk., 1898, lxvii, 261-300. (24) Zweifel: Referate über die Behandlung der Myome. Centralbl. f. Gynäk., 1899, xxiii, 613-618. (25) Mainzer, F.: Deutsch. med. Wchnschr., 1896, 393-396. (26) Burckhardt, G.: Ztschr. f. Geburtsh. u. Gynäk., 1900, xliii, 8-59. (27) Werth, R.: Klin. Jahrb., 1902, ix, 529. (28) Doran, Alban: Subtotal Hysterectomy for Fibroids. Lancet, London, Part ii, 1905, p. 1300. (29) Vineberg, H.: Surg., Gyn. and Obst., 1905, xxi, 559-567. (30) Graves, W. P.: Trans. Am. Gyn. Soc., 1917, xlii, 208-227. (31) Polak, J. O.: Trans. Am. Gynec. Soc., 1918, xliii, 105-114. (32) Tuffur, T.: Surg., Gynec. and Obst., 1915, xx, 30-34. (33) Mayo, W. J.: Jour. Am. Med. Assn., 1920, lxxiv, No. 25, 1685-1689.

22 East Sixty-eighth Street.

# Society Transactions

## NEW YORK ACADEMY OF MEDICINE
## STATED MEETING, HELD JANUARY 20, 1921

THE PRESIDENT OF THE ACADEMY, DR. GEORGE DAVID STEWART, IN THE CHAIR

The program of the evening was arranged in cooperation with the Section on Obstetrics and Gynecology.

DR. GEORGE H. RYDER read a paper entitled **The Administration of Pituitrin at Beginning of the Third Stage of Labor in One Hundred Consecutive Cases.** (For original article see page 61.)

DR. HERBERT M. LITTLE of Montreal read by invitation a paper entitled **The Least Common Multiple in Obstetrics.** (For original article see page 67.)

### DISCUSSION

DR. WILLIAM E. CALDWELL.—One hundred cases in which pituitrin was used as soon as the baby was born does not prove as Dr. Ryder states, that pituitrin will never cause trouble. But he certainly has shown that its use is safe as a routine in the majority of cases. There were no cases of really adherent placenta in Dr. Ryder's series. I think that an adherent placenta is comparatively rare, but it certainly does occur; and it is conceivable that the pituitrin might make the manual extraction more difficult. In such a case it might be better to wait until the effect of the pituitrin had passed off. Or, if there were a partial separation with bleeding, it should be possible to overcome the action of the drug with chloroform anesthesia.

I believe that an adherent placenta should be removed manually and the uterus packed. Having seen some of Dr. Ryder's cases, and having tried it on some of my own, I believe the uterus acts very much better during the third stage when pituitrin is used. It does not balloon up as much, and therefore it is easier for the nurse, with her fingers on the fundus, to keep track of its condition. In multiparae, I am disposed to believe that there are fewer after-pains if we use pituitrin in the third stage.

I formerly thought that there might be a relaxation of the uterus after the effect of the drug had passed. Very few of Dr. Ryder's cases required a second dose of pituitrin or ergot to keep the uterus in good condition.

DR. RALPH W. LOBENSTINE.—For over a year, in upwards of 115 cases, I have been using pituitrin during the third stage of labor. Briefly my practice has been to administer 5 minims directly after the birth of the child and from 5 to 8 minutes after the expulsion of the placenta. The only modification of this dosage has been that, in those cases with a history of sudden violent hemorrhage in the third stage, a full ampoule of the drug has been given at the first dose—this being followed, after the expulsion of the placenta, with one ampoule of aseptic ergot.

I still believe in carefully holding the fundus during the third stage and in gentle massage in case of relaxation. My nurses are taught to do this correctly and I

myself or my assistant verify this from time to time. My patients in this series have all been private patients. Many of them were in rather delicate health—women requiring close watching. The unnecessary loss of an extra six or eight ounces of blood is often of real significance. I have not noticed that the placenta is expelled any more quickly by this method, neither do I agree with Dr. Ryder that it is an advantage to have it expelled quickly.

This method has certainly seemed to lessen the amount of blood lost, but it causes at times a disagreeable amount of pain during the first 24 hours postpartum.

In this series, one case only required tamponade, aside from cases of placenta previa, abruptio placentæ and vaginal hysterotomy. Should this method be generally used? No, I do not think so. For average cases it is unnecessary; it is expensive and may be dangerous.

DR. JAMES C. EDGAR.—Broadly speaking, I am opposed to the use of any drug during labor and while pituitrin is most valuable and I make it a point always to have it ready for use, I should hesitate to use it as a routine. The figures of those who have used it as a routine procedure point to less bleeding and a shortening of the third stage of labor as a result. My chief objection to its use is that it causes after-pains. One almost always has to follow it with some sedative in order to control the terrific after-pains that will not permit the woman to sleep. In the 100 cases was there not considerable pain following the use of pituitrin? Another objection is uncertainty as to its action. We have tried different preparations and have come to the conclusion that its action was to a considerable extent dependent upon the susceptibility of the patient. In some patients it did not have any effect and in others it acted out of all proportion to what one would have expected. Its excessive action is a great objection. I am accustomed to give one dram of ergot after the third stage. I am opposed to any medication during labor without positive indications. Some one may say "What is a positive indication?" A positive indication, I should say, is what is indicated for the comfort and safety of the patient. I have given it at the end of the third stage and repeated it at the end of two hours, and that is all.

I do not see why we should insist on a certain time for the expulsion of the placenta. I do not see why one should fix on 20 minutes. I think, if necessary, one should wait 60 minutes. I am old fashioned enough to go back to the old way of waiting two hours if necessary, of course, watching the fundus. Pituitrin offers a tremendous advantage in allowing the obstetrician to give more attention to the baby, but it takes only a few minutes to care for the baby. I am quite in accord with the statement that the average nurse does not know how to hold the fundus. She gets hold of the adipose tissue below the fundus and the fundus itself will go five or six inches above and will fill up with a large blood clot. I think it is the obstetrician's duty to watch the fundus.

Dr. Little's paper has touched upon some tremendously important questions. I am not prepared to throw overboard lateral episiotomy, though I think it looks as if Dr. Pomeroy's contention is correct, that the median episiotomy is the proper one. I have seen patients come back in whom it was hard to find the incision, though that does not mean that the muscles beneath are not torn. The claim is made that with the lateral incision one cuts into the belly of the levator ani on one side. I feel that on the other hand, there are many advantages connected with the lateral incision, especially the healing and the lessening of the danger of cutting into the rectum. I wish Dr. Little would speak of the extension of the incision into the gut, for there must have been some such accident without question.

I agree with what was said about anticipating trouble and not doing anything unless there were positive indications. There is, however, something more than that. It is the duty of the obstetrician to anticipate emergencies and not to wait until a

woman has lost a great deal of blood and has a pulse of 120 before preparing to do something.

I am quite in accord with what was said in regard to nausea and vomiting, but am not entirely in agreement about the mild kidney cases requiring emptying of the uterus. In a mild kidney case emptying the uterus is not always indicated, and then we are often forced to carry these women through, particularly if they are Roman Catholics, and with care, proper diet and keeping the skin active, many can be carried through. Mild kidney lesions may sometimes improve later. I have known instances in which a woman has gone twice to the eighth month and lost her baby and then in a third pregnancy has gone to full term. Where the maternal instinct is strong the woman will sometimes insist upon taking the risk and I am inclined where the lesion is mild to belittle the risk; at all events we must sometimes take it, though the kidney lesion is increased by pregnancy. Broadly speaking, however, a kidney lesion demands emptying the uterus.

DR. F. A. DORMAN.—Fortunately all women do not take the view of pregnancy Dr. Little has pictured. Many pregnant women are full of optimism and do not think of childbirth as going through the "valley of the shadow." A certain proportion of women think it is a normal process. Dr. Little states that the pregnant woman can do pretty much as she likes. I disagree that they can be allowed their usual activities. Some can and are able to go through their pregnancy safely, but the woman who plays golf and tennis is apt to get herself into trouble and then she will ask why the doctor did not tell her to avoid unusual exertion. I advise against extreme, sudden, and violent exertion.

As to the nausea and vomiting, many women understand that a little nibble between meals will avert vomiting, but women who have an extreme aversion to food unless advised to eat frequently, neglect this precaution and suffer more severely.

Pyelitis we see occasionally but have not been flooded with these cases as Dr. Little says he has been. Very rarely do we get critical cases that demand emptying of the uterus. Personally I have felt that catheterization helped to find the stricture and that the patient responded to temporary drainage. I am a strong believer in the beneficial effect of posture, flooding the system with water, and urinary antiseptics. Ten years ago one of my patients had a baby which came to the eighth month. It weighed 4 pounds and, though undernourished, survived. Four years ago she had a second pregnancy accompanied by a very high blood pressure. The blood pressure was not taken during the first pregnancy. The baby died at the seventh month *in utero*. She now has a blood pressure of 170 mm. and a certain amount of albumin in the urine. That woman cannot see why she cannot be made well. In every borderline case if the woman has not had the advantage of treatment one may try careful diet and elimination and if she is a borderline case you may carry her through, but these are not the cases which are threatened with eclampsia.

I am a believer in rectal examinations. I believe we can learn almost everything in that way, but there are times when a vaginal examination is useful, and with surgical care I believe we do not get much morbidity. I would like to ask Dr. Little how he determines the condition of resistance of the cervix. Rectal examination of the cervix is not of the prognostic value that it would be if one had the finger in the cervix.

I would like to ask also what Dr. Little regards as the indications for episiotomy. Whether we should assume that we are going to tear the perineum and rather than have the possibility of sewing it up, do an episiotomy? It seems to me that the tendency at present is to lose heart and to do an increasing number of episiotomies. Where we have delivered a woman and preserved the perineum we have conferred a great boon upon her, though where there are vaginal tears it is well to proceed to

introduce the sutures before the patient comes out of the anesthetic. By prompt work we may avoid anesthesia in the third stage.

Dr. Little says he does not hold the uterus in the third stage. How does he know that the uterus is not filling up with blood? Also what is his rule where he discards cathartics? What is his rule in regard to enemas? We use the catharsis systematically on the third day, not because we think the patient cannot empty the rectum by an enema but because we think the catharsis relieves the distention of the breasts. I am heartily in sympathy with doing away with the breast pump. I think it gives an artificial stimulation to lactation. I also believe that an ordinary lump means very little and is not a cause for future abscess or mastitis, unless it occurs in the second week and is associated with a rise in temperature. The intrauterine douches we have discarded. We prefer to use postural treatment, elevating the head of the bed if there is faulty drainage.

DR. W. E. STUDDIFORD.—A report from the Metropolitan Life Insurance Company seems to show that there is an increase in puerperal sepsis and a very evident increase in the toxemia of pregnancy. It may be questioned whether there is a real increase in the number of cases of puerperal sepsis or whether we are getting better statistics. Several factors may be responsible for increases in the toxemia of pregnancy. It is my experience, however, that we are meeting with an increased number of kidney cases, not eclampsia. It is a question whether the recent epidemic of influenza has not had an effect on these women. We know that persons between twenty and thirty years of age were most affected and that many attacks of influenza were followed by cardiovascular or renal pathology. Is it not possible that we are reaping the results of the epidemic of influenza in the mild kidney affections that we are seeing. It is important that such conditions be recognized early and the pregnant woman placed under treatment. Many of the mild kidney cases can be carried through while in others there occur placental changes and death *in utero;* some go on and become cases of the eclamptic type.

As regards the question of pyelitis in pregnancy, my experience has not always been that of Dr. Little. There are not many cases that go on to the point where the induction of labor is necessary. Most cases under proper diet, rest and posture treatment, where there is pressure on the ureter, will be relieved. Another factor in pyelitis, I am not so sure but that many are due to focal infections—focal infections involving both the tonsils and the teeth. The development of alveolar abscesses in a pregnant woman should be promptly noted or they may result in further trouble. Contrary to the old idea that no dentistry should be performed during pregnancy, I consider that proper and conservative dentistry is necessary.

One thing I should like to correct. In the description of episiotomy, whether it is median or lateral, the statement is made that the levators ani are cut. They are not cut. If they were we would have a worse condition than that following laceration. I feel that advocating episiotomy as a routine is not to be encouraged, since suturing the incision is not the simple procedure sometimes described and requires a certain amount of skill in surgical technic.

I think all of us remember the time when no case was submitted to an abdominal operation unless ten or fifteen grains of calomel had been given at night and salts and an enema in the morning, with the result that when the abdomen was opened the intestines filled the wound. We now know that it is wise not to give any cathartic unless it is mild catharsis two or three days before operation. The same principle applies to the postpartum routine. We can remember when a cathartic was given to every one in a surgical ward as a routine. Cathartics given in that way work only harm. There are women who do not need a cathartic on the second or third day, or if they do they need one of the mildest type. There are others who need more active catharsis; some may get along with an enema.

DR. RYDER, (closing the discussion.)—Dr. Caldwell says that objection has been made to the use of pituitrin in the third stage of labor, on the ground that it makes management of adherent placenta more difficult. I do not see why this should be so. The action of pituitrin lasts only twenty or thirty minutes and the attempt to express the placenta is rarely made before this. If the placenta is found to be adherent then, the action of pituitrin has already worn off, so that it can have no effect on the condition or treatment. Dr. Caldwell also mentions the possibility of relaxation of the uterus after pituitrin, as a criticism of its use. A study of this series has not shown any such effect. In 93 of the series the uterus remained hard for one hour postpartum. In 6 it hardened and softened alternately. And in 1 only did it remain soft persistently till another dose of pituitrin or ergot was given.

Dr. Lobenstine said that he believed holding of the fundus during the third stage was always necessary as a routine precaution against hemorrhage. I entirely agree with him. I think that if those who advocate leaving the fundus alone during the third stage, could have the amount of blood lost actually measured in each case, they would be surprised to see how much it was. We all know that the uterus does balloon up and fill with blood at times. In every such case there will be unnecessary loss of blood. Why not prevent this loss if possible?

Hour-glass contraction was not seen in any of this series. In one case there was difficulty in expressing the placenta. Three different attempts were made at intervals of twenty minutes, and then under ether it was expressed. In the non-pituitrin series, however, two such cases occurred, and in these, even the last attempt under ether proving unsuccessful, the placenta had to be extracted manually.

Both Dr. Lobenstine and Dr. Edgar spoke of pain after the use of pituitrin. I have never seen this, and I have been using it postpartum for years. Of course, many multiparæ have after-pains whether they have been given pituitrin or not. But I believe, if anything, pituitrin and also ergot lessen this tendency, by preventing the formation of intrauterine clots. At any rate, the action of pituitrin is of such short duration that I do not see how many of the after-pains can be ascribed to its use.

I entirely agree with Dr. Edgar that ergot given postpartum adds to the comfort and safety of the patient.

Dr. Edgar says he does not like a specified time of twenty minutes for the expression of the placenta. He thinks that in many instances a wait of sixty minutes or even of two hours would be better. I can see no advantage in waiting such a long time as this, as a routine procedure. I believe it would add to the amount of hemorrhage and to the discomfort of the patient.

The methods of managing the third stage of labor are not at present entirely satisfactory. They cause the obstetrician much worry. They are not understood by the average nurse. They allow unnecessary hemorrhage. The administration of pituitrin at the beginning of the third stage of labor is an attempt at finding a more satisfactory method. Whether or not it will prove to be so, further investigation may show.

DR. LITTLE, (closing the discussion).—I regret that in my brief paper a number of things were omitted which have been brought up in the discussion.

In the nephritic cases, I did not mean that all pregnancies should be terminated, but few nephritics with a history of one eight months' premature delivery show improvement in a later pregnancy or carry the child for a long time. In such patients you can never fix the time for induction of labor. In the first pregnancy allow the woman to carry the child as long as she can and do everything to help her. While it is more or less hopeless, it is worth while trying. I have never been able to bring through to term a nephritic who had had two previous miscarriages. The blood pressure remains high and there is infarction and thrombosis of the placenta.

In regard to golf, tennis, etc., I did not mean that a woman should take unusually violent exercise, simply that she might do the things she was accustomed to doing. The average woman gets down and scrubs and does all kinds of housework. Why not play golf or tennis? It is impossible to prevent women from doing many of these things except by constant supervision, and I have seen no ill results from freedom.

The teeth may bear some relation to the infection of the kidneys. The primary condition, however, is the hydronephrosis, often due to constriction of the ureter by torsion just outside its junction with the bladder.

I have tried both median and lateral episiotomy. The majority of primiparas have had median episiotomy, particularly if forceps was applied. We hear the older obstetricians say they never had a perineal tear. The pelves of women today are different. They are narrower and there is a closer approximation of the tuberosities of the ischium and a shorter bi-ischial diameter. Therefore a smaller proportion of children can have a spontaneous birth. Very often you cannot save the muscles of the perineum unless it is cut, and cutting the perineum relieves pressure on the bladder and diminishes the possibility of cystocele. I believe that, if you do an episiotomy and repair it, the woman is better off in a future pregnancy than if the perineum has been much distended or irregularly lacerated. I have seen patients go through a second labor after episiotomy without any damage of the perineum.

Unless there is considerable bleeding, I think it is better to leave the uterus alone, but I do not wait two hours. The less anesthesia, the better the uterus contracts, and spontaneous contraction is better than that obtained by drugs.

Dr. Studdiford says that some of my patients were uncomfortable without catharties. Many, I believe, thought they were not getting enough attention. On the whole it has been pretty satisfactory, and a look at the charts will show that there were fewer rises in temperature in the patients who did not have catharties. Dr. Dorman spoke of a cathartic being given when the milk was coming in. It used to be thought that the giving of castor oil prevented milk fever. No one today believes in milk fever, and, if the woman is not going to nurse her baby, the milk will go just as quickly if you do not give a cathartic.

---

## NEW YORK ACADEMY OF MEDICINE

## SECTION ON OBSTETRICS AND GYNECOLOGY. STATED MEETING, HELD FEBRUARY 25, 1921.

### Dr. Harold Bailey in the Chair

Dr. Sidney D. Jacobson presented a case of **Familial Multiple Enchondroses Complicating Pregnancy.**

The patient, Italian, twenty-three years of age, pregnant for the first time. At the age of eight she developed a small chondroma of the wrist. The growth was removed. At that time she had no other tumors. Two or three years ago she was operated upon by Dr. Fowler of Brooklyn, who removed a portion of the right ilium. The tumor recurred and a year later was removed. It was examined microscopically and found to contain pure cartilaginous tissue. While pathologically these tumors are benign, clinically they are malignant. About one year ago I removed a growth from her abdominal wall. Within four months of the operation the woman became pregnant and it was found that she had a metastatic deposit higher up in the abdomen and one of more recent growth lower down. The older one of these tumors shows a softened center indicating mucoid degeneration. In this case the tumors

are of the familial type. The woman's father, who was also presented, has a characteristic bowing of the radius and ulna and a deposit on one rib. A paternal uncle had the same condition. The removal of these tumors does practically no good because they continue to recur and eventually one forms near a vital organ, causing death. The patient has been advised to have her pregnancy terminated. It is a question whether it is wiser to terminate the pregnancy or to remove the tumor. The tumors are large and their removal will mean the resection of a large portion of the abdominal wall, and with the uterus increasing in size there would be danger of a large ventral hernia. Another point that has influenced me in deciding to let the pregnancy alone is the fact that during pregnancy there is a deposit of calcium salts in the maternal body which nature removes later and I have hope that she might be cured in this way since our therapy has been unable to do so. The x-ray photographs shown demonstrate that the patient has these tumors in her legs, arms and in practically every bone of her body. Cases are on record in which an enchondroma has been known to perforate the bladder or pregnant uterus. Numerous cases have been reported in which paralysis has resulted from pressure of these tumors on a nerve, and cases of aneurysm are reported as a result of their impingement on blood vessels, their sharp point having lacerated the fibrous coat of the vessel.

### DISCUSSION

DR. H. C. BAILEY.—This case presents some interesting features. There is the question whether she should be allowed to go on with her pregnancy. There is no doubt that in this tumor there are malignant tendencies. We know that during or immediately after pregnancy there is a rapid growth of all tumors. A point that is both interesting and odd is that at the Memorial Hospital we have never had a case of general enchondrosis. Tumors of this type should be nonmalignant. Why does this one show a tendency to metastasize?

DR. FREDERICK W. RICE.—I have examined Dr. Jacobson's case. If the x-ray shows the pelvis free from the growth, I do not see why the pregnancy and labor should be affected in any way by the new growth.

DR. CHARLES B. DAVENPORT.—I am interested in this case because of the family history and have made inquiries of the father who himself shows the same osteoses. He states that his father, his father's mother, and a brother had the same condition.

DR. CHARLES CHILDS.—Before giving an opinion as to the desirability of terminating pregnancy I should like to know more of the patient's general condition. These tumors are not to my mind an indication for the interruption of pregnancy.

---

DR. ALFRED M. HELLMAN reported a case and presented a specimen of **Chorioepithelioma.**

Mrs. U., aged fifty, presented herself at my office, November 27, 1920. She had been married twenty-three years, had seven children, and several miscarriages. The youngest child was full grown. The last miscarriage was in February, 1920, nine months before I saw her. She quotes her physician as saying that at that time she was four months pregnant. She had had no complete cessation of menses. After curettage at that time she bled irregularly for from four to six weeks and then stopped for two weeks. Two weeks before coming under my observation she was again curetted for severe hemorrhage. This failed to stop the bleeding.

Her complaints were uncontrollable bleeding, at times slight, at times severe, and great weakness with some loss of weight. Her systolic blood pressure was 128, and her urine was normal. The uterus was only slightly enlarged, soft, and bleeding slightly. I thought I was dealing with a cancer of the fundus, but did not lose sight of the fact that my patient might have a sloughing fibroid, or an incomplete abortion.

On November 29, I performed a diagnostic curettage which was of negative value only. There was little tissue obtainable and this showed a small round celled infiltration and no malignancy. Despite my thorough curettage the patient continued to bleed, and not wishing to wait for another hemorrhage, I advised hysterectomy, on December 3, and performed it on the next day. A panhysterectomy was performed, and the round ligaments sutured into the vaginal wall for support. A small perforation of the fundus was found. Despite a slight infection of the abdominal wall the patient made an uneventful recovery and was enjoying better health than for over a year.

The pathologist's report states that externally the uterus, tubes and ovaries appear normal except for the puncture wound noted at operation. On making a longitudinal incision the uterine cavity was found filled with blood clot. In transversely incising the fundus there was a slight protrusion of a deeply seated mass not previously visible, containing yellow and dark brown spots suggesting chorioepithelioma. The growth was not over ¾ of an inch in its greatest diameter. Microscopic sections show chorionic villi, syncytial masses, and a large number of Langhan's cells and numerous congested areas with heavy fibrin, and in places occasional mitotic figures and coagulation necroses. Along the course of the perforation are found syncytial masses, chorionic villi, Langhan's cells and mitotic figures, evidently a secondary growth. The diagnosis was chorioepithelioma.

Summarizing, we have here a woman almost beyond the child-bearing stage, with multiple pregnancies developing a chorioepithelioma with a secondary growth in the organ of origin, operated about nine months after the onset of the trouble, and enjoying perfect health ten weeks after total hysterectomy.

At the time I curetted the patient I had no suspicion that she had chorioepithelioma. We thought she had fibroids at the time of the menopause that were responsible for the continued bleeding. I did a most thorough curettage, but the bleeding kept up. I thought it only fair to the patient, whose hemoglobin was down to 50, to do a panhysterectomy. A careful study of the specimen explained the condition with which we were dealing.

---

Dr. Hervey C. Williamson reported **Two Cases of Extraperitoneal Rupture of Lower Uterine Segment.**

Case 1.—K. M., Admitted to the Bellevue School for Midwives December 18, 1916. Age 32, para iii. Last menstruation in April, 1916, exact date not known. Expected confinement January, 1917.

Surgical history.—A gynecologic operation was done six years ago, the exact nature of which was unknown to the patient. Subsequent to delivery the uterus was found adherent to the abdominal wall.

Menstrual history, normal. Began at fourteen, 28-day type, duration 3 to 5 days. No pain or other symptoms.

Previous pregnancies.—One long labor followed by forceps with stillbirth. One spontaneous abortion at two and one-half months.

Mensuration of the pelvis, normal.

Operative procedure.—The patient was seen on the afternoon of the 20th, having

been in active labor more than 24 hours. The head was just dipping into the superior strait, the position right occipitoanterior, and the cervix four fingers' dilated. The membranes were ruptured and there was no fetal heart. The patient was transferred to the Obstetrical Department of Bellevue Hospital. The patient was prepared and anesthetized. The cervix was dilated manually and the head perforated in the usual manner. After the solid blade of the Braun cranioclast was introduced within the cranial vault, the cervix was found to be so firmly contracted about the head that the fenestrated blade could not be introduced. The Tarnier forceps was then applied with difficulty, the compression screw tightened, and the head delivered. There was some difficulty delivering the shoulders but cleidotomy was unnecessary.

After the delivery a deep tear was discovered on the left side of the cervix extending through the vaginal vault and about 9 or 10 cm. into the lower uterine segment. The tear was vertical and extraperitoneal. The placenta and membranes were removed manually and the body of the uterus packed firmly, the tear was loosely packed. The cervix was united with three interrupted sutures and the vagina packed. The patient lost only a moderate amount of blood as the tear apparently did not traverse vessels of large caliber. She left the operating room in fair condition with a pulse rate of 130. Hypodermic injections of pituitrin 1 c.c., and ergot were given.

The packing was cautiously removed 24 hours later and pituitrin 1 c.c. given. The puerperium was uneventful aside from mild abdominal distention for the first three days, relieved by enemata. She went home on the ninth day postpartum.

The dystocia in this case was probably caused by irregular uterine retraction the result of ventrofixation. There was a deep lower segment tear with slight loss of blood and little shock. The treatment by packing and suture was effective.

CASE 2.—M. C., Admitted to the Bellevue School for Midwives December 12, 1920, age thirty-two, para x. Last menstruation in April, 1920, exact date not known. Expected confinement January, 1921.

Surgical history.—Amputation of the cervix and perineorrhaphy, September 18, 1915. Menstrual history, normal. Began at fourteen, 28-day type, duration 3 to 5 days, slight backache, no other symptoms.

Previous pregnancies.—Four full term children with normal labors, 14, 12, 10 and 7 years ago. These were conducted by midwives. Two miscarriages and three abortions, all spontaneous. Three occurred between the third and fourth pregnancy, and two afterward.

Mensuration of pelvis, normal.

Operative procedure.—The membranes ruptured spontaneously on the day before admission. The patient was examined at home, a transverse presentation, left scapuloposterior, was found with the cord prolapsed and pulsating. On examination at the hospital the cord was presenting at the vulva, strongly pulsating. The cervix was two fingers dilated, thick, but felt soft. Manual dilation was attempted. When the cervix was about two-thirds dilated, the left side suddenly opened into the lower uterine segment. The tear was vertical, about 10 cm. in length, and extraperitoneal. As there was very profuse bleeding the hand was immediately passed into the uterus and an internal podalic version and breech extraction performed. A premature living baby was delivered, but it could not be resuscitated. The placenta was immediately expressed by the Credé technic, the uterus, tear into the broad ligament, and the vagina packed tightly using about 35 yards of gauze. The tear was enlarged slightly by the delivery so that it was about 12 cm. in length. As the patient was in shock, a hypodermoclysis of 1000 c.c. was given. Ergot, pituitrin, camphor, and strychnine were given by hypodermic. Later a Murphy drip was used intermittently for 24 hours.

The patient recovered from the shock and on the following day the vaginal and

a little of the uterine gauze was removed. On the second day the remaining portion was removed. The puerperium was uneventful until the fifth day when, for no apparent reason, she had a moderately profuse hemorrhage. This was controlled by massage of the fundus, ergot by mouth, and morphine by hypodermic. She was not examined as the bleeding had stopped before our arrival.

Nothing further happened until the nineteenth day postpartum when she complained of pain in the left popliteal space, and on the following day a typical femoral phlebitis was in evidence. On the twenty-ninth day patient complained of pain in the right chest, and on the thirty-second day of pain over the region of the spleen, these symptoms suggested small infarcts. On the thirty-sixth day the phlebitis extended to the right leg. On the fifty-seventh day she had pain across the lower abdomen. Vaginal examination shows extensive pelvic thrombophlebitis.

The patient had an irregular temperature until the sixty-seventh day when it became normal and remained so. She went home on the seventy-fourth day on her own responsibility. Her general condition was good but there was still some edema of the lower extremities.

This case presents a traumatic rupture of the lower uterine segment, treated by packing, and complicated by pelvic and femoral thrombophlebitis.

## DISCUSSION

DR. GEORGE W. KOSMAK.—This case demonstrates the conservative method of handling rupture through the lower uterine segment where the peritoneal cavity is not involved. We have had three such cases recently at the Lying-in Hospital. Two occurred in tenements. They were packed with gauze, sent to the hospital and made good recoveries. The third case occurred two weeks ago. The patient was a para ii who had a difficult labor. When the attending physician reached the hospital there was a history of spontaneous rupture of the membranes unaccompanied by pain and the patient seemed quite comfortable. There was a breech presentation and the cervix was dilated two fingers. The liquor amnii had drained away. A No. 4 Voorhees bag was inserted without anesthesia about 10 A.M. In a few hours active labor pains set in and the patient was delivered in the course of the afternoon. Two hours later the patient went into shock, the placenta having been retained. She was seen by a member of the attending staff who attempted to deliver the placenta but could not do so. I later found a tear extending through the lower segment of the uterus up to the round ligament. There was no tear in the cervix, however; I could introduce my hand through the cervix and into a hole on the left side of the uterus. There was very little bleeding. In fact I never saw so little bleeding in a case of this kind. As the woman was in shock we put in a gauze packing and gave her hypodermoclysis. She ran a temperature for two or three days and then it came down. An attempt was made to get the placenta this afternoon but we could not find it although we spent some twenty minutes exploring the uterus; all we found was a few tags of tissue. The particular feature in this case was the extensive rupture within the cervical ring and yet the cervix was not torn. The patient made a complete recovery. This is simply another instance demonstrating that we can treat these cases conservatively with good results.

DR. CHARLES GARDNER CHILDS, JR.—An interesting point in these cases is that in the first instance rupture occurred because the cervix was not fully dilated before the forceps were applied while in the second case it occurred because the cervix was rapidly dilated. The second case is an example of the fact that manual dilatation is an operation not always without dangerous results. I would like to emphasize the desirability of instrumental dilatation in preference to manual dilatation, for I feel that manual dilatation is far more dangerous than instrumental dilatation. I would like to know the length of time occupied in dilatation of the

cervix in the second case. Often during manual dilatation the hand becomes so tired that one uses more force than he realizes.

DR. WILLIAM E. STUDDIFORD.—The operative procedure in those cases is of great interest. As I understand it, in the first case there was a ventral fixation which did not allow of regular uterine contraction and there was imperfect dilatation of the lower segment. In such cases rupture of the uterus usually occurs higher up. The second cases gives the not uncommon history of a hurried effort to dilate the cervix after labor has begun. I think one reason for the rupture in this case was due to failure to recognize the relation of the fascial supports in doing the repair on the cervix at the previous operation. The muscular fibers were probably not brought together and the fascia brought together over them. In doing an ordinary circular amputation, the fascia should be stripped free from the muscles; the muscle fibers should be brought together first and the fascia brought together over the muscle in suturing the stump after amputation of the cervix and then one is less likely to have a rupture.

With reference to dilatation, I recall one case in which there was very little dilatation. An attempt was made to dilate with steel retractors clamped on the lips of the cervix. This was not successful and a cesarean section had to be performed. This woman had a subsequent pregnancy and a second cesarean had to be done for the same condition. This is one of the difficulties to be taken into consideration in amputating the cervix during the childbearing age.

With reference to the fact that there was little hemorrhage, the rupture does not usually involve the uterine artery, though the circular branch may be involved but it may have been ligated at the amputation. These ruptures are not accompanied by acute hemorrhage unless these vessels are involved.

---

DR. W. E. CALDWELL and DR. W. G. LYLE presented a paper entitled **Blood Chemistry in Pregnancy.** (For original article see page 17.)

DISCUSSION

DR. S. R. BENEDICT.—It is difficult to attempt any summary or conclusions of any type from so much data without an opportunity of examining them in more detail. A few points may, however, be touched upon.

This is a very important contribution and helps to complete the picture of metabolic studies reported by previous investigators. Murlin and Carpenter, and Murlin and Bailey have reported excellent studies of the total metabolism and the urinary findings in pregnancy. The present paper adds the blood picture in pregnancy and eclampsia. Perhaps the most striking results reported are the tendency to low nonprotein nitrogen and urea. Such figures as three to five milligrams of urea nitrogen per 100 c.c. of blood, as are here reported in some cases, have, I believe, not been duplicated in any other condition. It is obviously difficult to attempt an interpretation of these findings, but they suggest a line of reasoning which might be attractive. We must bear in mind that in pregnancy a condition exists where the same circulating fluid must supply both a growing and a stationary organism. A similar condition exists to a varying degree in cases of cancer, and it is very interesting to note that Miss Theis and Dr. Stone reported low urea and nonprotein nitrogen figures for cases of rapidly growing carcinomas of the breast and uterus. If we apply a primary law of physical chemistry to the growth process, we should infer that the growth of cells could be augmented by either increase in concentration of the reacting substances (food products) in the surrounding medium, or by decreasing the concentration of the products of the reaction (waste products). From this stand-

point then, the lower concentration of urea in the blood in pregnancy would tend to favor growth of the fetus. The similar finding in cancer is in line with this point of view. As Dr. Caldwell pointed out, although Murlin and Bailey reported that the urea elimination in the urine during pregnancy is below normal, due to retention of nitrogen by the fetus, which would ordinarily be eliminated as urea, this fact offers no explanation whatever of the low concentration of urea found in the blood in pregnancy. It must be that the condition of pregnancy offers a very specific stimulus to the kidney, which responds by maintaining a distinctly lower level of urea concentration in the blood than obtains under the usual conditions.

The study of amino acid nitrogen in the blood of both mother and fetus should be extended. This fraction of the nitrogen in the blood is probably used for tissue building, and it is interesting to note in the few studies reported that there is a definite increase in the amino acid content of the blood of the cord.

Concerning the rise in uric acid in the blood reported for eclampsia and previously noted by certain observers during labor, it may be stated with reasonable certainty that this finding cannot be explained through the increased muscular activity of the uterus, but that we must regard such uric acid accumulation in the blood as indicative of kidney insufficiency.

The main problem of the intoxication in eclampsia remains unanswered. At least there is nothing in the present findings which will tell us whether the failure of the kidney at a certain stage is cause or effect of the toxemia. Probably both factors are involved.

DR. CALDWELL, in closing the discussion.—In one case that died the autopsy showed an acute kidney condition and a typical eclamptic liver. This case had the highest ratio of urea nitrogen to nonprotein nitrogen, a ratio of 76. The cases in which there was a low ratio of urea nitrogen to nonprotein nitrogen recovered while those with a high ratio died. There was, however, not sufficient uniformity in the ratio of urea nitrogen to the total nonprotein nitrogen to permit one to classify the eclampties into groups on that ground.

---

DR. FRANCIS WARD LANGSTROTH, JR. read a paper entitled **Focal Infection of the Cervix and Its Relation to Systemic and Nervous Diseases.**

(*Author's Abstract*).—It has seemed best to divide the study of this subject into two parts: 1. A consideration of all those facts which show that the endometrium of the cervix frequently becomes the site of focal infection, which is second to no other in its resulting systemic effects. 2. An analysis of 50 cases operated for the removal of this focus of infection at the New Jersey State Hospital at Trenton.

The writer wishes it understood that he does not claim that all cases of insanity can be cured by simply removing the diseased endometrium of the cervix, nor does he wish this paper to be construed as in any way sensational, but the results from this procedure in many of the cases operated upon were so pronounced that he feels it a duty to present the facts for consideration.

A study of the histology of the mucous membrane lining the cervical canal shows that we have here in the cervix a tissue well suited to become the permanent abode of pathogenic bacteria, and this has been proved to be a fact. Sturmdorf has shown photomicrographs of the cervical endometrium from cases suffering from chronic endocervicitis, which show all the classic signs of inflammation due to bacterial invasion. The writer has had numerous pieces of cervical endometrium cultured by the direct method in the laboratory at the New Jersey State Hospital at Trenton, and almost all of them produced a growth of pathogenic bacteria. In a previous paper

the writer reports the results of swab cultures taken from 60 cases of chronic endocervicitis among which only one was negative. (Preservation of the Procreative Function in Woman, *New York Medical Journal*, June 5, 1920.) In over 95 per cent of some 75 cases operated upon by the writer for the removal of their infected cervical endometrium, and reported in a former paper, the results were most gratifying. These patients were cured of all their pelvic symptoms and their leucorrhea was stopped; besides which they were markedly benefited in their general health (The Treatment of Infections of the Uterus and Cervix—A Preliminary Report of 75 Cases, Medical Record, June 28, 1919). The object of the present report is to establish the fact that chronic infection of the cervical mucosa with pathogenic bacteria occurs with great frequency and that it may become a focus of infection just as prone to cause systemic and mental manifestations as foci in the tonsils, teeth, sinuses, intestinal tract, etc. There is every reason to expect these results because the cervix is very freely supplied with blood and lymphatic vessels into which absorption of toxic products and even bacteria can take place.

We have had 29 of these cases of chronic endocervicitis infected either with the streptococcus or colon bacillus and in 13 others some form of staphylococcus was found, making a total of 42 cases in which a virulent infection was present. If then focal infections occur and cause remote effects anywhere, certainly the same is true in the light of these researches in the cervical endometrium.

In the present series of 50 cases, operated upon at the New Jersey State Hospital at Trenton, 58 per cent showed the same infection in both the stomach and cervix. This points strongly to a hematogenous or lymphatic transference of bacteria. Of these cases 44 per cent were infected with the streptococcus and 34 per cent were infected with the colon bacillus. Sixty per cent of the cases were infected with these two organisms either singly or combined. These findings agree with those in the first series and as far as can be determined with my cases of private practice, so that this probably represents the bacterial flora of chronic infection of the endometrium lining the cervical canal. Most of these cases reached the gynecologic service after every other focus of infection that could be found had been removed. They all, with two exceptions, exhibited clinical signs of chronic endocervicitis. The operation employed was the tracheloplastic method described by Sturmdorf which on account of its descriptive value acquired the name at the State Hospital at Trenton of "plastic conical enucleation of the cervix," although various methods and modifications were employed. The fundamental object, however, was to remove completely the infected cervical endometrium. In addition ten perinorrhaphies were performed, in one of which an additional cystocele operation was done and one or both ovaries were removed in two of the cases. There were no deaths, and a gynecologic cure was obtained in practically all the cases, with a marked improvement in general health and a gain in weight that was very pronounced in most instances. As to the mental results, eighteen cases were improved after the removal of the teeth, tonsils, etc., but none were cured. From removal of the foci in the cervix 21 cases were improved, 15 of these having shown no improvement after the removal of other foci, while six had shown some improvement from the former work. After removal of their infected cervical endometrium 17 cases were reported by the hospital to have recovered mentally, 11 of these having shown their first improvement after removal of foci in the teeth, tonsils, etc. Six others showed no improvement until the cervical work was done, then recovered. Among the mental conditions in the improved cases were the following: Exhaustion delirium, manic depressive insanity, not classified; manic depressive insanity, depressed; epilepsy, constitutional inferiority, dementia precox, paranoid condition, psychasthenia and imbecility. Among the conditions reported as cured were manic depressive insanity, not classified;

manic depressive insanity, manic; manic depressive insanity depressed, toxic psychosis, hypomanic, neurasthenia, dementia precox, and one unclassed case.

We feel now fully justified as a result of this work in placing focal infections of the cervical endometrium upon a firm basis, second to no other, as a factor in the causation of systemic, mental, and nervous manifestations and diseases. And while we should not promise too much from a removal of these foci, still, no one would seem justified in treating many of the chronic diseases today without having all these foci sought for and removed by some one especially trained in his respective field.

DR. MAURICE O. MAGID.—When I saw the title of Dr. Langstroth's paper I assumed that the writer meant chronic endocervicitis. I am sorry that he did not use that term in the title, because chronic endocervicitis is now coming to be recognized as a pathologic entity. We used to speak of endometritis until it was proved that endometritis does not exist; that the changes in the endometrium are those which take place during the menstrual cycle. When Sturmdorf reported the results of his studies on chronic endocervicitis, he called attention to the pathologic possibilities that may accompany this local infection.

In my association with Dr. Sturmdorf for the past eight years, I had the opportunity to observe the various manifestations, both local and remote, all of which proved his contentions to be correct. There is proof in the literature that adnexal disease such as tubal distortion, cystic disease of the ovary, has as its primary cause this focal infection. The remote systemic manifestations, as depicted by Dr. Langstroth, are just as possible when we consider the infected cervical mucosa in the same relation as infection of the teeth or tonsils.

The cure for this focal infection has been described as a conical enucleation of the cervical mucosa. It is too bad Dr. Langstroth did not use the word "trachelo-plasty" when he spoke of the operation, as he really performs the operation devised by Sturmdorf. When this operation is described under another name, many men do not immediately grasp the fact that it is really the tracheloplastic operation.

If Dr. Langstroth has proved to the satisfaction of all present, that systemic and mental disease may be benefited by this operation, I feel that we have just cause to disagree with the older authorities who maintain that any repair on the cervix of women in the childbearing period should not be attempted.

Such contentions are correct if one considers the Emmet operation by which the two raw surfaces of the lacerated cervix are sewed together. A great deal of the diseased cervical canal is retained and continues to act as a focus of infection. Sims' amputation has also many disadvantages, one having been shown by Dr. Williams' case of dystocia and rupture of the lower uterine segment. Leonard's statistics on Sims' amputation bear out this fact. Following the tracheloplastic operation, patients may readily conceive and there is seldom, if ever, any dystocia encountered in labor. I have a series of cases operated upon by this method in whom the labors had almost been precipitated rather than prolonged. A number of my patients who had remote disturbances in their joints were cured by the tracheloplastic operation.

As to the young woman cited by Dr. Langstroth, who had been mentally ill since she was sixteen years of age, there probably existed an endocervical infection in her early childhood. With the onset of menstruation, the infectious process which had been dormant, became active.

I am sorry to take exception to Dr. Studdiford, who, in speaking of Dr. Williams' case, said that the possible cause for rupture of the lower uterine segment is the inclusion of the fascia when suturing the stump after amputation. There is no

fascia under the mucous membrane covering the cervix. According to Sturmdorf, the muscle fibers of the uterus are arranged spirally and do not at any point completely surround the cervix. These muscle fibers end in the cervix in a serried succession of oblique circle segments which uncoil when the uterus contracts. This dilates the os like the iris diaphragm of a microscope. After amputation, the mechanism is disturbed because the muscle tissue in the stump is bound down in the scar, thus producing the difficulty in dilatation with the possibility of rupture of the lower uterine segment.

DR. HENRY A. COTTON, NEWARK.—I desire to emphasize the need of co-operation among the various specialists in attacking such a problem as we have tried to attack at the State Hospital. Scarcely any medical problem can be worked out by one set of men alone. From time immemorial the psychiatrists have taken care of mental diseases and only when they began to realize how much help could be obtained from other sources did they begin to get results. Where there is infection there is no doubt that results may be obtained by eliminating that source of infection.

We had one interesting case, a girl who gained seventy pounds after the removal of a focus of infection. She first came under our care at the age of sixteen or seventeen. After a time she improved and was discharged. Her mental trouble recurred six years later and she was under our care again for two years. She was found to have an impacted molar and an infection of the tonsils following an endocervicitis. The removal of these foci of infection resulted in a wonderful improvement. The girl is now a nurse in the hospital doing work she could not have done in her former condition. It is just as important to look for an endocervicitis as it is to ascertain whether the seminal vesicles are the focus of an infection. There have been cases in which every other focus of infection was removed without benefit until a focus in the seminal vesicles was discovered and removed and then the patient recovered. Following the elimination of cervical and other foci of infection we have had patients recover and remain well long enough to warrant the statement that their recovery is not merely temporary.

DR. GORDON GIBSON.—I agree that focal infection has a great deal to do with systemic disease, but I cannot say that it causes insanity or that its removal will cure insanity. We have not gone so far as to say that we have cured insanity, but we have grouped our cases into two general types, first, those characterized by dementia. In these we found that no operative procedure or medical treatment helped the patient, so we have disregarded dementia precox and epilepsy, conditions in which the patients are badly deteriorated, and we confined our work to those psychoses not characterized by deterioration. It is just these cases where the removal of teeth, tonsils, scar tissue, tumors, old adhesions, pustules, or any irritation at all, may be beneficial. We know that in sane women such irritations may give rise to nervous symptoms, and that the removal of the source of irritation will relieve the symptoms. Again we classified these cases in respect to the attack. If we saw the patient in the first attack we knew that sooner or later there would be another attack and we have tried to ward off the next attack. We have operated on some in the seventh attack. In those having a first attack all we hoped to do was to put the patient in the best possible physical condition and thus possibly to remove the exciting cause of the insanity. Then we have to watch them ten, fifteen, twenty years and see what happens to the woman; that is what we are waiting for. Of those operated on during the first attack we have found in the large number of cases that if there was a secondary admission the attack was milder and of shorter duration. In a series of cases operated in the second attack and seen in the third attack it was interesting that in at least five we have been able to increase the duration of

sanity between the attacks. One must remember, however, that about 80 per cent of these patients come from neuropathic stock and that any little disturbance or shock or systemic disease or toxemia will bring on an attack. I know of a case where one drink of whiskey served to bring on an attack. These patients just on the borderline of insanity are easily pushed over, and if one can demonstrate a pathologic process that can be removed, one is justified in operating in that type of insanity and the prognosis will depend upon the type of insanity under consideration. Acute intoxications may cause a woman to become insane, and if the infection is removed, the woman recovers, but there one is dealing with the actual cause of the insanity.

When I first started out with this investigation I was very enthusiastic, but after studying a thousand cases I became somewhat discouraged; one reason results were not satisfactory was that the women who went out from the hospital did not get good obstetrical care with their subsequent babies. Some of them had puerperal mania, which by the way is a misnomer; the term puerperal psychosis would be better. Where there is an underlying neuropathic condition, pregnancy or labor or the puerperium may be an exciting cause of insanity and therefore better care during pregnancy, labor and the puerperium will help in lessening the liability of these women to insanity.

DR. LANGSTROTH, in closing.—I would like to ask Dr. Gibson whether he made a definite effort to remove all the cervical endometrium up to the internal os. That is important. I have written previous papers on endocervicitis and given credit to Dr. Sturmdorf, describing his operation and I mentioned twice that the operation of choice is Dr. Sturmdorf's. It acquired his name early and I think many term it a plastic conical enucleation of the cervix. I have never had any intention of detracting from Dr. Sturmdorf's work; quite the opposite. I have named the condition a focal infection deliberately because I have never seen anything written as to the part played by the cervical endometrium in focal infection. I wished to put it on the same basis as infection of the tonsils and the teeth. Dr. Sturmdorf may have called attention to that, but I feel that this work has put chronic endocervicitis on a different basis, the basis of focal infection and nothing else. Furthermore, I believe that this is the first series of cases in which the attempt has been made in cooperation with other workers to benefit insanity and the neuroses, and certain cases have been helped by nothing else than the removal of this focus of infection. This is a report of focal infection and not on endocervicitis. The emphasis is laid on the removal of the focus of infection and is not a discussion of the methods of removal. In 17 cases a complete recovery was made and so they stand. They are practically all out of the hospital.

With reference to the type of insanity. I believe that practically all the cases cured were of the type which I understand do not show any destructive lesion in the brain substance. Manic depressive insanity, I understand does not show any microscopical alteration in the brain structure.

My personal explanation of the whole subject is that a toxic material of some kind is circulating in the blood and in certain cases it causes rheumatism, etc., and in some cases mental disease, and that in certain types of cases the removal of the focal infection entirely clears up the mental disease.

DR. COTTON.—We have a functional group of so-called dementias of which 77 per cent have recovered following the removal of all the foci of infection. I think Dr. Gibson's trouble was in limiting the work and in not giving attention to teeth and tonsils. The cause of many psychoses is infection; that has been substantiated and definitely proved. The hereditary and psychogenic factor is contributory, and the infection is primary. This will be realized in a short time.

## OBSTETRICAL SOCIETY OF PHILADELPHIA, STATED MEETING, JANUARY 6, 1921.

THE PRESIDENT, DR. EDWARD A. SCHUMANN, IN THE CHAIR

DR. JOHN A. MCGLINN read a paper entitled "**Tubercular Vulvitis.**"

Dr. McGlinn referred to the infrequency of tubercular infection of the external genitals and reported three cases personally observed at the Philadelphia Hospital during the previous summer.

All three cases were in colored women and were primary, no other part of the body being affected as far as could be determined. All the cases were chronic, the earliest case being of two years' duration and the oldest eight years. Two of the cases presented small lesions of the vulva, typical ulcerations, with edema of the surrounding tissues. One case presented very extensive ulceration involving both

Fig. 1.—Tuberculosis of the vulva. Dr. McGlinn's case.

vulva, mons, and the buttocks. The general health of all the patients was excellent. They were unable to determine the source of infection in any case. The cases were interesting to the residents and students who saw them, from the diagnostic standpoint. Not one diagnosed the correct condition, carcinoma and syphilis being the two diagnoses made. Syphilis was the unanimous diagnosis made in the case which showed a 4 plus Wassermann.

The diagnosis was confirmed in all three cases by microscopic studies.

The cases were treated by the roentgen rays but Dr. McGlinn was unable to record the final results.

### DISCUSSION

DR. G. W. OUTERBRIDGE.—I have seen two cases in colored women during the past year at the Graduate School of the University. The first patient had a marked

swelling of the left labium just as in the picture of Dr. McGlinn's case, a vaginal ulcer and numerous papillary growths in the lower vagina. At operation we suspected either tuberculosis or syphilis. She had a four plus Wassermann. The general appearance led to a diagnosis tentatively of tuberculosis, which was subsequently confirmed by careful study of numerous sections which demonstrated tubercle bacilli in the tissue. The second woman presented a single sluggish ulcer on the left side of the labia. The microscopic section was not characteristic; it simply showed granulation tissue. The Wassermann reaction was negative on repeated examination. Treatment by roentgen rays made the condition markedly worse and had to be stopped. Dr. Schamberg saw the case and in spite of the negative Wassermann advised treatment by arsphenamine which produced marked improvement. She disappeared before the ulcer was entirely healed; but it was well on the way to healing. Whether this was a tuberculous ulcer it is impossible to say.

DR. JOHN M. FISHER.—I have seen a few cases. The characteristics that impressed me particularly were these: the patients were young, from twenty to twenty-five, the ulcerations were painless and of a serpiginous character, with coincident ulceration and cicatrization going on at the same time and intervening healthy structure. The cases that I saw were in the wards of Jefferson Hospital a number of years ago. At that time we treated them by curettement followed by the application of iodoform ointment and as a matter of course the constitutional treatment of the patient was not neglected.

DR. PHILIP F. WILLIAMS.—The paper called to my mind a colored woman who came to Dr. Girvin's service in the Presbyterian Hospital, with an ulcer about 1 cm. in diameter on the left labium minus. It was a punched-out ulcer about one-eighth inch deep, covered with a slight exudate. The general physical and pelvic examinations were negative. The Wassermann reaction was negative. A piece of excised tissue did not show tubercle, neither did it show any changes suggesting malignancy. The exudate subjected to dark field illumination showed no spirochetes. This woman was referred to Dr. Newcomet for radium treatment at the Oncologic Hospital and had three treatments and then went out of the hospital and I did not see her for three or four months. There was practically no change in the ulcer. I do not know whether that was tuberculous or not, but it illustrates the difficulty in diagnosis of ulcerative conditions about the vulva.

DR. EDMUND B. PIPER.—Dr. McGlinn will be interested in hearing of a young colored woman who presented an ulcer similar to that described by him, except that it covered more ground, about 6 inches in diameter and 8 inches long. We think it is both tuberculous and syphilitic.

---

## Dr. Edmund B. Piper presented a pair of scissors designed for perineotomy.*

This instrument is designed especially for median episiotomy, but may be used equally well by those who are accustomed to do the lateral episiotomy. Dr. Polak of New York rather insists upon the name perineotomy rather than median episiotomy as the proper name for this operation. His position in this matter is anatomically and obstetrically correct. This instrument is a modified bandage scissors. The angle of the blade in relation to the handle is approximately twice as acute as that of the ordinary bandage scissors. The scissors are grasped in a manner which would be upsidedown for a bandage scissors and the handle has been so arranged

*This instrument is manufactured by Harvey R. Pierce Company, 18th and Chestnut Streets, Philadelphia, Pennsylvania.

that when the blade is placed in the vagina the upper handle will be approximately parallel to the floor. The guard is curved downwards and backwards, so that in cutting, when the unguarded blade is placed at the point on the skin perineum where the cut is designed to end, the guard will push the rectum out of the way of any possible incision.

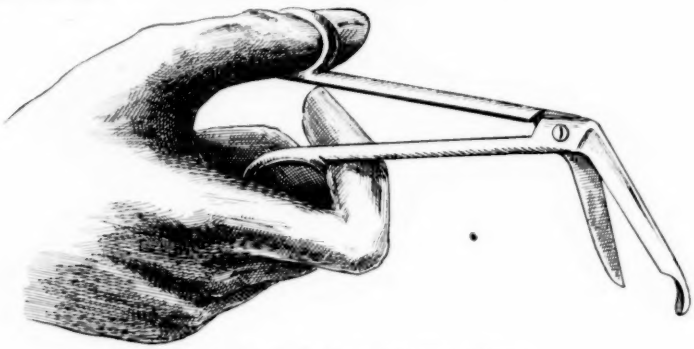

Fig. 1.—Dr. Piper's perineotomy scissors.

The principal advantage of the scissors is that perineotomy or lateral episiotomy can be done with the operator's hands in an easy position in both the normal case and the forceps case.

## DISCUSSION

DR. JOHN M. FISHER.—I believe that episiotomy in many cases is done where a more satisfactory delivery would occur without it. In my experience an expected perineal tear of consequence not infrequently fails to materialize, and to have subjected such a patient to the operation would certainly expose her to the same risk that an unavoidable tear in another patient followed by primary repair would entail. Episiotomy in rare instances may be called for but to resort to it as a routine procedure is carrying operative measures in obstetrics to extremes.

DR. WILLIAM E. PARKE.—I have not adopted the routine practice of perineotomy but have employed it from time to time where it seemed appropriate; and at different times have been both pleased and disappointed in the result. When the median incision was used the tear has extended at times beyond the cut, thus nullifying the purpose of the operation; and not rarely when the operation was contemplated and not done, the end result showed that it was not necessary—no tear occurring. When everything works out as designed it is most satisfactory. I have adopted the lateral incision after some disasters with the median incision and find the coaptation of the parts more difficult and the resulting scar more conspicuous. I do not make the incision until the perineum is distended.

DR. JESSE O. ARNOLD.—Since the discussion has turned from the instrument to the operation, I will say that I am a firm believer in perineotomy. I have been doing this operation for a number of years and the more I do it the more favorably impressed I am with its advantages and good results. I see no reason now to believe from my experience that I will give it up. I think the more one studies and practices this method of aid in delivery the better pleased he will be with it. It seems to me that one of the greatest steps in modern obstetric progress has been that toward the doing away with the second stage of labor, as illustrated by the work of Potter of Buffalo, DeLee, Beck, and others of our own city, and this means in the majority of cases, a perineotomy. If we are going to deliver early and to a great extent take away the dangers both to the child and the mother, of the second stage

of labor, which I am quite sure we can do in a large majority of the cases, then we must either do as Potter does, dilate the birth canal with our hands—which I am not so sure that many of us would do so successfully as he appears to do it—or we must open it by an early, free incision of the perineum. I have been somewhat of a disciple of DeLee in his contention that the delivery of a child is a surgical procedure. I have gone to his clinic and watched his work, and am convinced that he and his assistants are doing the best work that I have seen along this line. So much have I been impressed by it that I am trying as far as I can to follow their methods and technic and must say that my results have been very satisfactory, both to myself and my patients. I have had a number of patients for second delivery and have invariably found conditions good. I do the lateral oblique operation. It should be done *early* to get the best results. When it is done early, the incision carried deeply through the muscles, and proper repair made, the results, in my opinion, will be far better than those usually obtained by prolonging the second stage for dilatation, either with or without evident tear.

DR. JOHN M. FISHER.—I would like to ask Dr. Arnold in what percentage of cases he does this operation?

DR. ARNOLD.—I do it on practically all primiparae and all multiparae that have had proper care in previous deliveries, before the head has pressed to any considerable extent upon the floor and before there is a stretching out and submucous separation of the fasciæ and muscles.

DR. NORMAN L. KNIPE.—I agree in part with Dr. Arnold and do episiotomy on most primiparae because it does prevent severe perineal lacerations. Lately I have been doing the Potter method of version quite frequently and find that by this method I get very few tears even without episiotomy. The more I do the Potter method the better I like it. Criticism of the method implies that the detail of the Potter method is not carried out. It is necessary to carry out every single part of Dr. Potter's version in order to get good results.

DR. JOHN A. McGLINN.—When you extend discussion to perineotomy and prophylactic forceps and Potter's version, it is far from the subject of the paper—"A Scissors Designed for Perineotomy." I may be old fashioned, but I have always looked upon labor as a physiologic process and I have come to look upon the most dangerous obstetrician as the "skilled professor who at the present time must do something to help the woman out." It is a queer thing that here recently we have been arguing that a man should not examine a woman unless he had on a pair of rubber gloves, then that he should not examine by the vagina but by the rectum and then we turn around and use all sorts of queer surgical devices to save a woman perhaps a half hour of pain. I cannot understand why we do this, except that it simply means we are tired of doing the things which we have conquered, there is very little left for us to do and we start on these new things. Potter's version is not good obstetrics, prophylactic forceps is not good obstetrics. I think if the men treat their cases in a normal, sane way and give Nature a chance they will find they have just as good results.

DR. GEORGE M. BOYD.—For a time I resorted to episiotomy. Then I stopped cutting the perineum in the median line or laterally because I found that it in no way diminished the frequency of the tears which are of moment in these cases. I refer to the deep internal tear of the vagina, either in the anterior wall or in the posterior wall, often involving the muscular support of the pelvic floor. The last median episiotomy I did was followed by a vaginal tear extending up the left sulcus and involving some of the fibers of the levator ani muscle. I am in accord with Dr. McGlinn in regard to the conduct of labor in general. I do not think that we are

warranted in cutting short the length of labor without a specific or definite reason. In the two operations recently suggested, prophylactic version or forceps extraction, why should we resort to major surgery simply to cut short the normal second stage.

DR. EDMUND B. PIPER.—In the first place I want to say that in presenting these perineotomy scissors I was not recommending episiotomy as a routine procedure. I belong to the school of intermediate repair, but I do episiotomy in certain selected cases. Dr. Arnold in speaking about episiotomy in regard to the position of the head in the birth canal, does it a little higher up than most of us.

I agree with Dr. McGlinn about forceps. I do not believe that Dr. McGlinn disagrees that if you cut the perineum a little to help a patient along that there is any objection to it. Dr. Boyd's criticism against perineotomy is in regard to a tear in the sulcus. Many times a tear occurs in the sulcus when episiotomy has not been done, and it is not so easily recognized. I do not believe that Potter's version or any other one way of doing things should be a routine procedure.

# Department of Reviews and Abstracts

CONDUCTED BY HUGO EHRENFEST, M.D., ASSOCIATE EDITOR

## Collective Review

### The Treatment of Abortion

BY F. L. ADAIR, M.D., MINNEAPOLIS, MINN.

THE treatment of abortion must be considered from two points of view: (1) prevention of abortion itself; (2) prevention and treatment of the complications incident to abortion. The prevention of abortion necessitates an understanding of the causes. The predisposing and active causes of abortion have been classified by Taussig[1] as follows:

*Predisposing causes.* 1. Increased sensitiveness to nerve stimulation. 2. Greater tendency to placental thrombosis. 3. Lessened resistance to expulsion. *Exciting causes.* 1. Mechanical irritation. a. Transmitted. b. Direct irritation. 2. Thermic irritation. 3. Toxic irritation. 4. Nerve irritation. 5. Death of the fetus.

It is also necessary to deal with the different forms of abortions. We will first discuss (1) Induced abortion under three headings: (A) Self-induced. (B) Criminal abortion. (C) Therapeutic abortion, next take up: (2) Habitual abortion; (3) Missed abortion; (4) Pathologic abortion; and (5) Spontaneous or unintentional abortion. Under this last heading we will consider: (A) Threatened abortion; (B) Inevitable abortion, [(a) infected; (b) noninfected] (C) Incomplete abortion [(a) infected, (b) noninfected]; (D) Complete abortion [(a) infected, (b) noninfected]. We also subdivide all of the above types of abortion into those with serious hemorrhage and those without serious hemorrhage.

In speaking of serious hemorrhage, we shall consider first hemorrhage from two points of view: (1) immediately serious hemorrhage; (2) remotely serious hemorrhage.

(1) *The Immediate Dangers of Hemorrhage.*—The consideration of statistics indicates that fatal hemorrhages in cases of abortion and miscarriage are rare. Neu[2] in a recent article was able to cite only two cases of death from hemorrhage following abortion. One of these is not authentic. In the Frankforter Clinic from 1909 to 1920 in a total number of 4000 cases, there was no fatal case of hemorrhage. In Mecklenburg Schwerin, having a population of 600,000 people, from 1886 to 1909 no fatal cases of hemorrhage under five months gestation were reported. Hegar in forty years' experience never saw a fatal case of hemorrhage under three months pregnancy. Neu also found that of the 2279 cases from 1914 to 1920, in 1118 instances vaginal tamponade controlled bleeding. It is interesting to note in this connection that in 1914 to 1915—67.1 per cent of the cases were packed; 1915 to

1916—74.2 per cent; 1916 to 1917—71.4 per cent; 1917 to 1918—69.4 per cent; 1918 to 1919—11.7 per cent; 1919 to 1920—16.4 per cent. The reports of statistics of many other authors show practically no case of fatal hemorrhage. It may therefore be concluded that the danger of death from acute anemia is not very great especially in the first three months of pregnancy. It is somewhat greater in the second trimester though still very slight. Not over 8 or 10 per cent of abortions and miscarriages need any vaginal packing at all.

(2) *The Remote Dangers of Hemorrhage.*—Either one profuse hemorrhage, several moderate hemorrhages, or continuous moderate hemorrhage may prove of danger to the patient in that she is rendered more susceptible to infection. This clearly leads to the conclusion (1) that the attendant has and must take plenty of time to prepare the patient and himself before packing the patient; (2) that this is important on account of this greater susceptibility of anemic patients to infection. I might add from my own experience that in these cases absolute rest, elevation of the foot end of the bed, plenty of fresh air and avoidance of all manipulation are usually sufficient to arrest the hemorrhage. I have also found that in many cases pituitrin and ergot immediately aggravate the hemorrhage until the uterine contents are expelled, by exciting more active uterine contractions. On the other hand, I have found that the administration of a small dose of morphine gr. $\frac{1}{8}$ to $\frac{1}{6}$ together with atropin gr. $\frac{1}{200}$ to $\frac{1}{100}$ usually quiets the patient and checks the bleeding. I wish to call attention to the fact that codein is dangerous in these cases. I would advise against its use.

If it is necessary to interfere the patient should be carefully prepared and placed in the lithotomy position. The instruments should be carefully sterilized and the attendant himself prepared as for any aseptic operation. The speculum should be inserted and blood clots and unattached tissue removed from the vagina and cervix. The vagina should then be tightly packed, preferably with iodoform gauze, though plain gauze or cotton may be used. General treatment as for any other case with hemorrhage should be instituted.

*Threatened Abortion.*—In a number of cases of threatened abortion I have been surprised at the amount of blood which could be lost and the patient still go to term and be delivered of a normal child without detriment to herself or her offspring. I, therefore, advise against interference in these cases too quickly or without due consideration. Any case of pregnancy associated with spasmodic backache, pain in the lower abdomen of cramp-like character, especially if associated with uterine hemorrhage belongs to this group of cases. The treatment consists of absolute rest in bed continued for at least one week after the subsidence of all active symptoms, and return to bed on recurrence of any of the symptoms, the avoidance of cathartics, the use of small enemata or suppositories if necessary. So far as drug therapy is concerned, in my experience nothing compares to full doses of morphine and atropin. This should be administered as quickly as possible after the onset of the symptoms, preferably hypodermically in dose of morphine gr. $\frac{1}{4}$ and atropin gr. $\frac{1}{100}$. This is to be repeated and pushed to the physiologic limit if necessary. It often is difficult to tell when a threatened miscarriage becomes inevitable. Fever, odorous discharge, escape of amniotic fluid, shreds of membrane, indicate that it is inevitable. It should then be treated as such.

*Missed and pathologic abortions.*—Many of these threatened abortions, especially in the first six weeks are really pathologic and hence inevitable. Mall[3] has shown that a very considerable percentage of abortions in the first six weeks is associated with faulty embryonic development. This leads us to a brief consideration of what is known as missed abortion where the ovum, usually pathologic, is not discharged but is retained in the uterus for a number of weeks or months with slight or no symptoms. These conditions can only be diagnosed by watching the case and noting the nondevelopment of the uterus and the failure of the pregnancy to progress.

*Inevitable Abortion without Fever.*—In case of serious hemorrhage the uterus should be emptied immediately, as soon as proper preparation is made. Without hemorrhage, one may wait for spontaneous expulsion or remove immediately. There is practically no danger with proper technic in emptying a noninfected uterus.

*Inevitable Abortion with Infection.*—If there is serious hemorrhage, it should be controlled by vaginal packing to be removed within 24 hours when the uterine contents may come away or be easily removed. In infected, inevitable cases without hemorrhage, the uterus should be left alone until patient is afebrile for several days. If cultures are made in these cases and streptococci found, all intrauterine manipulations should be avoided. In any case where the uterus has once been entered, it should not subsequently be re-entered, at least not until it is certain that the patient is having an afebrile convalescence. Some authors advise the emptying of the uterus in these cases in the absence of streptococci, and if properly done it is not a serious procedure. Others advise waiting until the patient is afebrile from two and one-half to five days. If the pregnancy is under eight weeks, the uterus can be emptied at one sitting, by dilating the cervix and removing the contents with forceps or a dull curette. It is relatively safer to use instruments within the uterus under ten weeks than it is later because the uterine wall is firmer and thicker. It may be necessary in cases beyond eight weeks to use vaginal packing, bougie or bag for 24 hours before uterine contents can be removed, which should then be done carefully with forceps or finger. The use of the curette should be avoided in these cases.

*Incomplete Abortions.*—These cases make up by far the largest percentage of the cases. McPherson[4] figures that about 13.7 per cent of cases are complete, leaving about 86 per cent incomplete. The incomplete abortions according to Williams quoted by King[5] have a ratio of about 5 to 1 in hospital cases and about 3 to 1 in general practice. Paul Titus[6] estimates that about 66 per cent are incomplete. King[5] reports 121 cases of complete and 145 of incomplete abortions in his series. It is evident that the majority of cases are incomplete. Some authors go so far as to state that there is no such thing as a complete abortion. Vineberg[7] in an analysis of 287 cases of incomplete or inevitable abortions at Mt. Sinai Hospital during a period of five years found 60 with a temperature from 101° to 105° many of which were induced. All of these cases were curetted as promptly as possible after admission to the hospital. There were 2 deaths, making a mortality of about 3 per cent. He advocates active treatment for cases with retained tissue only.

Hallis[8] studied a series of cases at the Cook County Hospital analyz-

ing 200 cases which had a minimum temperature of 100° on the day of admission. These were divided into two groups of 100 cases each. In Group I the uterus was emptied artificially and promptly. In Group II treatment was expectant. He found that the febrile cases treated expectantly had fewer days of fever, shorter stay in the hospital, fewer complications, and a lower mortality. He concluded that no operative procedure should be carried out until the patient had been afebrile for at least five days. The uterus should be emptied only in case of alarming hemorrhage. The author ran a second series of cases which after a five day period without fever were assigned alternately to operative and expectant treatment lists. Of those on the operative list, only cases with persistent or profuse bleeding or retained placental tissue were curetted. On the expectant list, they were curetted only for hemorrhage. In the second series, no striking difference was noted between active and expectant treatment lists in days of fever, lochia, or stay in the hospital. Mortality was nil. His general conclusions are as follows: (1) Cases of septic abortion should receive no local treatment until free of fever for five days, except for hemorrhage; (2) Nonseptic cases should be curetted as a routine because: (a) 40 per cent have to be curetted, (b) curettage insures an empty uterus and prevents subsequent bleeding, (c) it shortens the stay in the hospital, and (d) the procedure is relatively harmless and accomplishes good.

Convert and Vignes[9] from a study of the literature relative to abortion conclude that the bacteriologic studies have not furnished sufficiently constant results to give us any definite indications for prognosis or treatment. They think that in uncomplicated abortions, noninterference is a method of choice. It is difficult to tell which is best in complicated cases, active or expectant treatment. Intervention is unanimously accepted in cases of retention and hemorrhage. They conclude that it is very difficult to determine the best treatment, especially in complicated cases.

Boldt[10] advises for incomplete abortions hot antiseptic douches with vaginal tamponade and, if necessary, tamponade of the cervical canal. In cases without bleeding, no manipulation is required.

McPherson[4] analyzes 3500 cases from the New York Lying-in Hospital. For incomplete abortions he recommends packing the uterus with iodoform gauze after proper preparation, removing any easily accessible clots or fragments of tissue with finger or forceps, removal of the packing in 24 hours followed by curettage. He advises against intrauterine douches and suggests the wiping out of the uterus with gauze and the application of tincture of iodine. This radical treatment was used in 2800 of the 3500 cases with a mortality of 3 per cent.

A committee of the American Medical Association on puerperal fever[11] in compiling their questionnaire drew the following conclusions: The majority of obstetricians and surgeons clean out a septic uterus at once. A considerable minority advocate expectant treatment, believing that ovular remnants are not particularly dangerous. It was generally agreed that a uterus once emptied should not again be invaded.

Watkins[12] believes that retained products of conception should be left to escape spontaneously. In individual instances, gauze packing

may be used to check bleeding, to hasten the separation of the tissue and to stimulate uterine contractions.

Ries[13] in discussing a series of 156 cases with a temperature of 100° F. or more concludes that cases of abortion without fever may be safely left to terminate spontaneously except in profuse hemorrhage. He thinks that the same rule applies to septic abortion, and advocates expectant treatment, no vaginal examination, as little manipulation as possible, packing only if required by hemorrhage, removal of packing in 12 to 24 hours, manual removal of uterine contents if necessary, no vaginal or uterine douche, no repetition of packing.

Titus[6] in an analysis of 274 abortions found a mortality of about 4 per cent. Of these 162 were incomplete. Seventy-three of these were infected, with 5 deaths. Mortality was 6.6 per cent of infected cases of 3.7 per cent of all incomplete abortions. Sachs,[14] with infection limited to the uterus, advises curettage unless a hemolytic streptococcus is present. In the latter case he advocates rest until the temperature is normal and the streptococci have disappeared, when the uterus should be emptied.

Müssler[15] in a study of 141 cases of febrile abortions favors expectant treatment. Cases are usually afebrile in two and one-half days. In his series there were 5 deaths, about 3 plus per cent. He advises two and one-half days' rest before any attempt is made to empty the uterus.

Kolde[16] analyzes 1318 cases in most of which the uterus was emptied immediately with a mortality of 3.2 per cent of all cases, 7.1 per cent of febrile cases, 3.8 per cent of the cases treated actively. He advises the dilatation of the cervical canal and the emptying of the uterus with the finger. Under five months he uses Hegar's dilators or laminaria, after five months, a small metreurynter or performs hysterotomy, removing the ovum with Winter's forceps and irrigating the uterus with hot, normal saline solution. Tampon was used only exceptionally.

King[5] advocates noninterference except in cases with profuse bleeding and in those cases where placental tissue appears at the opening of the cervix. He treated 145 incomplete abortions, and had no deaths in the series with noninterference.

It is clear from the above citations that there is no great unanimity of opinion regarding the treatment of incomplete abortion. It is hardly necessary to point out that a mortality of 3 per cent is not a negligible one. It would deter many from performing an abdominal operation. So far as hemorrhage in relation to incomplete abortion is concerned, we have already indicated that the immediate danger of hemorrhage is practically nil, there being almost no fatal cases of hemorrhage in all the series of cases which have been accumulated. The remote dangers of hemorrhage are very slight unless accompanied by infection. The important point of attack in the treatment of these cases is not so much to control the hemorrhage as to prevent infection. The cases of abortion which usually are infected are the self-induced, criminal, and those cases of spontaneous abortion which have been subject to vaginal manipulations. Without vaginal manipulation, the percentage of infections in abortions would be almost nil. It, therefore, behooves those responsible for the care of these patients to avoid any vaginal manipulation, even digital examination unless strictly indicated. When indicated, it should be conducted with the

most careful aseptic precautions. The prophylaxis of these infections would accomplish much more than the treatment of them after they have been acquired. Rectal examination gives considerable information of value.

We can safely conclude that retained products of conception, except in so far as they provoke hemorrhage, are in themselves not dangerous to the patient. It is the infection which is to be feared. Afebrile patients with incomplete abortion, with or without bleeding, may have the uterus emptied with relative safety if the procedure is properly carried out. Febrile cases, with or without hemorrhage, should be handled very cautiously. If the bleeding necessitates interference, as little should be done, as is necessary and that with the greatest possible gentleness. In most cases the cleansing of the vagina and careful packing would be sufficient. It also seems apparent from the literature that if a bacteriologic examination is made, the presence of streptococci, especially the hemolytic variety, constitutes a definite contraindication to active treatment. It is much better to leave all febrile cases alone and not invade the uterus during the febrile stage. A period of from two and one-half to five days without fever renders intrauterine manipulation relatively safe. We may state, then, that incomplete abortions are not dangerous unless infected; that infected, incomplete abortions are not particularly dangerous unless actively interfered with during the febrile stage; and that after active therapy is once instituted, the uterine cavity should be left alone. In general it may be said that most incomplete abortions become complete after time is allowed for Nature to expel the remnants. Briefly, the treatment of incomplete, infected abortion consists of expectant treatment, interference only to control hemorrhage, rest in bed, plenty of fluid, good nutriment, and an abundance of fresh air.

*Complete Abortions.*—These cases rarely present much difficulty from the standpoint of hemorrhage. It usually can be controlled by other means than local treatment. Noninfected cases require no treatment except rest and general hygienic measures. Infected cases should never be treated actively except for drainage of a uterus in malposition, or of localized abscesses. The treatment is that of all infections, which has already been outlined.

One might go into a great deal of detail regarding the treatment of the *complications of abortion.* Some of these complications are sterility, repeated abortions, local inflammatory processes, septicemia, pyemia, trauma, subinvolution, or persistent bleeding. A very large percentage of gynecologic operations are necessitated by these complications. Probably as high as 50 per cent of cases of salpingitis, requiring operation, have followed abortions. We have, therefore, in the prophylaxis and treatment of cases of abortion to consider not only the immediate mortality, and morbidity, but also a remote mortality and morbidity due to these complications.

All *induced abortions* carry with them a definite menace of infection, in self-induced and criminal abortions mortality and morbidity are very high. Therapeutic abortion when properly performed has a mortality varying greatly with the conditions which necessitate their production. The danger of coincident genital infection is relatively slight. Such abortions represent a very considerable percentage of the total number of abortions. How genital venereal infections can be

prevented and controlled is a matter mainly of education. It is more of a social than a medical problem. An ascending infection in this class of cases can never be obviated. The limitation or prophylaxis of *unintentional abortion* requires the careful supervision of prospective mothers beginning very early in pregnancy, or, if possible, even before. Much can be accomplished by appropriate attention on the part of the patient and her attendant to signs of threatened abortion. Many of these cases need not reach the inevitable stage. The treatment of repeated or habitual abortion is very closely connected with this problem. Many cases who have one abortion will have another unless properly cared for. McPherson[4] found that 27 per cent of cases having abortions gave a history of previous abortion, 9 per cent more than twice previously. The proportion of abortions to births varies greatly. Paris maternities[4] gives as the ratio about 1 abortion to every 8 births; Russian maternities, 1 in every 10; New York Lying-in Hospital, 1 in every 8; Kyssner, 1 in every 5.6; Markoe, 1 in every 23.6; Taussig, 1 in every 2.3. In the analysis of a series of cases made a number of years ago, I found it 1 in every 3 plus. All these figures prove the relative frequency of this condition.

The treatment of *repeated abortion* requires careful study to determine the cause. Too frequent repetition of pregnancy is one cause, especially repetition following an abortion. At least six months to a year should elapse before subsequent pregnancy takes place. Mechanical conditions in the uterus such as malposition or cervical lacerations, are a factor in many cases and these conditions should be corrected. Traumatic causes, overwork, overexertion, should be avoided. Infection and infectious diseases may be causative factors. Syphilis has been overestimated as a cause for early abortion. This disease operates more disastrously in the latter half than in the first half of pregnancy. Disturbance of ovarian function may be responsible in some cases. The actual cause, however, cannot be ascertained in a considerable number of cases of premature interruption of pregnancy.

In the main, treatment consists as far as possible in the removal of the local cause where it can be found; avoidance of strain or undue fatigue; removal of sources of infection; improvement of general condition of patient; administration of corpus luteum in selected cases; rest in bed in certain instances; administration of uterine sedatives when necessary; and the avoidance of undue emotion and excitement of any kind.

REFERENCES

(1) Prevention and Treatment of Abortion, Mosby Co., 1910. (2) München. med. Wchnschr., 1920, lxvii, 1350. (3) Johns Hopkins Hosp. Repts., 1900, ix, 1. (4) Jour. Am. Med. Assn., 1912, lix, 709. (5) Jour. Am. Med. Assn., 1920, lxxv, 147. (6) Am. Jour. Obst., 1912, lxv, 960. (7) Am. Jour. of Obstet., 1917, lxxv, 975. (8) Surg. Gyn. and Obstet., 1920, xxxi, 605. (9) Progrés Méd., Jan. 25, 1919, p. 30. (10) Jour. Am. Med. Assn., 1906, xlvi, 791. (11) Report of a Committee on Treatment of Puerperal Fever. Section on Obst., Gynec., and Abdom. Surg., Am. Med. Assn., 1913, 64th Annual Session, p. 177. (12) Surg. Gynec. and Obst., 1912, xiv, 13. Surg. Gynec. & Obst., 1918, xxvi, 400. (14) Zentralbl. f. Gynäk., 1912, xxxvi, 193. (15) Zeitschrift für Gebürtshülfe und Gynäkologie, 1920, lxxxii, 382. (16) Monatschr. f. Geburtsh. und Gynäk., 1920, li, 17.

# Selected Abstracts

## Gynecologic Radiotherapy

**Eden and Provis: Uterine Fibroids and Chronic Metritis Treated by X-rays.** The Lancet, London, 1921, cc, 309.

The authors base their report on the results obtained in a total of 76 cases, treated by x-rays. Forty-six of the cases were uterine fibroids and 30 cases of chronic metritis.

In selecting their cases they considered; (1) the age, (2) the size of the tumor, (3) the character of the hemorrhage, (4) the degree of anemia and (5) the presence of complications such as inflammatory disease of the appendages, degeneration of a fibroid, etc. The age of preference was thirty-eight years or older, because the deleterious action of the rays upon the ovary is of vastly less importance when the patient approaches the climacteric. Fibroid tumors extending above the level of the umbilicus were rejected because the shrinkage in such large tumors often is not sufficient to relieve all mechanical symptoms. They considered the type and amount of hemorrhage important because in cases of irregular or interval bleeding, or in any atypical bleeding suggestive of carcinoma, the uterus should first be further investigated to exclude cancer. The use of the x-ray is contraindicated in patients with severe anemia because the first and often the second treatment often are followed by considerable hemorrhage. Consequently only the simple and uncomplicated cases are really suitable for x-ray treatment.

The technic adopted in most cases was a modification of that used in Krönig's clinic at Freiberg, the principle being the administration of massive doses of x-rays in the shortest possible time commensurate with safety as regards the skin of the areas irradiated. Two conclusions were arrived at; namely, the importance of giving massive doses and the administration of the treatment for one or two sittings after amenorrhea had been induced.

They protected the skin with a three millimeter aluminum filter, and further by a linen bag containing a loofah sponge enclosed in chamois leather, together with four layers of satrap paper. The amount of x-rays administered was roughly judged by placing a piece of Kienböck photographic paper, a strip of bromide of silver paper, over the area irradiated, which when developed served as a rough guide to the amount given. The technic is described by the authors in detail. Each treatment comprising exposures on two consecutive days, lasted three to four hours. The abdominal areas were radiated on the first day and the sacral areas on the second day. They found the time of choice for the treatments to be shortly after the termination of a period. Three weeks were allowed to elapse between treatments, as a precautionary measure against injury to the skin, the requisite number of treatments being four to six. The time dosage varied considerably, the limits being two hours and twenty-seven minutes to fifteen hours and thirty-five minutes.

The tumors in most cases showed rapid and marked shrinkage, while in some cases they actually disappeared. In only 10 of the 76 cases did they fail to produce complete amenorrhea and in only 4 of

the 10 cases was the treatment completely unsuccessful in affecting the flow.

The general changes produced in their cases by this treatment varied. Some patients complained of mild fatigue, while in others there was relatively severe prostration. In a few the treatment had a stimulating effect. The changes in the skin, exposed to the rays, were slight, the most severe being a mild dermatitis. Aside from the local changes of the pelvic organs already mentioned only in one case developed a generalized pelvic inflammatory process several months after the last treatment.

Some patients had prolonged and severe "flushing". A majority gained in weight, but in no instance was noticed any loss of the feminine qualities of mind or body.

In conclusion the writers believe (1) that x-ray treatment should be the method of choice in women over thirty-eight years of age for all uncomplicated cases of severe hemorrhage due to chronic metritis or other conditions in which no neoplasm is present; (2) in uncomplicated fibroid tumors not exceeding the height of the umbilicus, occurring in patients over thirty-eight years of age x-ray should be regarded as the method of choice, and (3) all cases should undergo a careful and complete gynecologic examination to exclude malignancy, degenerating fibroid, and inflammatory complications before being subjected to this treatment.

NORMAN F. MILLER.

**Knox: Treatment of Uterine Fibroids by Radiation.** British Medical Journal, 1920, No. 3119, p. 535.

The author advocates very strongly the management of cases of uterine fibroids by gynecologists and radiologists working in conjunction. He thinks gynecologists must recognize x-rays and radium as valuable adjuncts in treatment. The Coolidge tube offers distinct advantages. Most satisfactory is a 3 millimeter filter of aluminum with a secondary filter consisting of chamois, thick paper, and a loofah sponge. He gives as contraindications to treatment by x-ray and radium: (1) calcareous degeneration, (2) most forms of extensive degeneration, (3) possible malignant disease of the uterus, (4) infective conditions, (5) inflammatory conditions of adjacent organs, and (6) submucous pedunculated fibroids. In his opinion radium possesses certain advantages over the x-rays, most important among them the facility of application and the accuracy of dosage.

F. L. ADAIR.

**Williamson: Advantages and Disadvantages of X-ray Treatment.** British Medical Journal, 1920, No. 3119, p. 537.

The author wishes for a better understanding of the problem by both the radiologists and gynecologists. He emphasizes the almost certain favorable operative results in the treatment of fibroid, and points to the fact that not all cases are suitable for x-ray treatment. Unsuitable are (1) patients under forty years of age, (2) all cases favorabe for myomectomy, (3) degenerative changes in the fibroid, (4) large tumors, (5) recent or old inflammatory lesions of tubes or ovaries, (6) malignancy, (7) pressure symptoms upon bladder, rectum, nerve trunks or veins, (8) fibroids complicated with ovarian cysts, (9)

fibroids complicated by pregnancy and (10) grave anemia with red cells less than 2½ millions and hemoglobin below 35 per cent.

F. L. ADAIR.

**Lockyer: Radiology in Gynecological Practice.** British Medical Journal, 1920, No. 3119, p. 539.

The author sets forth his conclusions as follows: (1) Radiotherapy acts by destroying the ovaries and by a destructive action on the cells of the myoma, (2) radium and mesothorium are not as suitable as x-rays because they do not cause shrinkage of the growths, (3) x-rays combined with radium or mesothorium produce prompter hemostasis than x-rays alone, (4) The French cross-fire with intensive technic gives the best results, (5) treatment is useless for submucous growths, (6) radiotherapy should be used only in cases uncomplicated by adhesions, degeneration, and malignancy, (7) gynecologists must determine the indications for treatment and watch the clinical development, and (8) radiotherapy is not a substitute for, but an adjunct to operative procedures. Further experience has caused the author to modify his views slightly. He thinks the use of radium might be extended to cases of chronic metritis and fibroids.

F. L. ADAIR.

**Martindale: Intensive X-ray Therapy vs. Hysterectomy for Fibromyomata of the Uterus.** Archives of Radiology and Electrotherapy, 1920, xxv, 97.

In a series of 118 cases of uterine fibroids seen by the author since 1914, 25 cases remained either untreated or were treated by medical means alone. Of the remaining 93, hysterectomy was performed in 47 cases, myomectomy in 4 and intensive x-ray therapy was employed in 37.

The author concludes that x-ray treatment is to be preferred in the cases in which menorrhagia is the prominent symptom, when the fibroid is interstitial and does not exceed in size a six months' pregnancy. In cases where the fibroids are definitely pedunculated, in cases of submucous fibroids, or where malignancy was suspected, and, finally, in tumors larger than a six months' pregnancy, hysterectomy was performed. Serious organic diseases influenced the choice in favor of x-ray even in the larger tumors. Occasionally economic factors had to be taken into consideration.

The author gives his technic in detail. The average number of treatments given was 7, at 3-weekly intervals; the average number before amenorrhea was produced 4. Diminution in size of the tumor with relief of pressure symptoms comes on gradually and continues long after the cessation of the treatment. The amount of reduction, usually about half the original size, is mentioned in only 5 cases in his analysis. Menopausal symptoms are not severe.

A fresh series of two or three treatments was required because of a return of menstruation after an interval of some months in four cases. Two cases did not develop amenorrhea. One was subjected to hysterectomy two months after the seventh treatment; the other refused operation and was lost sight of after nine treatments. Four other cases were subjected to laparotomy following x-ray, two be-

cause of pain or pressure symptoms, one because of rapid growth of a multilocular ovarian cyst which had been mistakenly diagnosed as a soft fibroid and a fourth because of later development of a malignant tumor primary in the omentum, although she had been well and had had amenorrhea for a year following her 4 treatments. This patient died 10 days after her operation, all others with the exception of three which could not be traced, were in good health at time of writing.

MARGARET SCHULTZE.

**Nogier: Radium Treatment of Uterine Fibroids.** Journal de Radiologie et d'Electrologie, 1920, iv, 537.

Radium rapidly checks menorrhagias and metrorrhagias even in young women. In the majority of cases, there is a marked diminution in the size of the fibroids; often even a complete disappearance. These results are obtained in the minimum of time and without any risk to the patient. Radium is the only kind of treatment available in exsanguinated patients and those afflicted with serious lesions of the heart or kidneys. Radium is superior to x-rays because it can be applied in the diseased organ itself, usually "in the geometric center of the organ." The skin is least endangered, whereas in x-ray therapy the skin receives most of the rays. Neighboring organs receive but a very attenuated dose of the radium rays and thus are not subjected to unnecessary irritation. If there happens to be an unrecognized carcinoma present, the radium directed against the fibroid will, at the same time, destroy the cancer cells. Finally, radium acts quickly and usually a single exposure is required. At most, the treatment will last only one week, and there are no untoward by-effects as after x-ray treatment.

Submucous fibroids, very large tumors with marked pressure symptoms, calcified or necrotic fibroids, cervical fibroids, the coexistence of adnexal tumefactions or of carcinoma call for surgical intervention. In all other cases, radium is preferable to surgery because it is simple, free from danger and devoid of shock or any of the surgical complications, and because it accomplishes a complete result without keeping the patient in the hospital longer than one week.

GEORGE GELLHORN.

**Vineberg: Myomectomy vs. Radium and X-ray in the Treatment of Fibroid Tumors in Women Under Forty Years of Age.** Medical Record 1920, xcix, 91.

The author states that myomectomy is by far the more conservative procedure in women who still have some years to the menopause than is either radium or the x-ray. In the first one there is conservation of the menstrual function; in the other two (if they are successful) menstruation in most instances permanently ceases and all the distressing phenomena of the artificial menopause appear. In a series of 120 myomectomies there was not a single death. Of the 31 private cases in the series, 9, or 27.7 per cent conceived afterwards. In none has there been a recurrence of the fibroid growth or of menorrhagia, although many of the patients were operated upon more than 5 years ago. In cases of hemorrhage, the uterine cavity should be opened and endometrium curetted under control of the eye, as advocated by W. J. Mayo.

C. O. MALAND.

**Nordentoft: A New Suggestion for Radium Treatment of Uterine Cancer.** Ugeskrift for Laeger, 1921, lxxxiii, 76.

Nordentoft states that several German surgeons have given up the combined roentgen-radium treatment of uterine cancer and instead have adopted exclusively the roentgen treatment. The chief objection against radium is the unsatisfactory effect radium has on tissue lying at some distance. A necrosis of the tissue next to the radium is practically unavoidable if the dose is large enough to affect the remoter ramifications of the cancer. Recently, however, Amreich has described some means of overcoming this particular difficulty.

Nordentoft emphasizes the fact that the cancer spreads from the uterus into the tissues of the pelvis on both sides, resembling the shape of a butterfly. The wings are spread from wall to wall of the pelvis. He therefore, introduces one tube of radium into the cervix and then a second or third tube through a tunnel into the obturator foramen, on both sides if both parametria are affected. If 50 mgms. of radium with 1 mm. brass filter and black paper are placed into each of these three places for 22½ hours in one application, a permanent cure of the cancer can be expected. Nordentoft feels that only continued observations will show whether this treatment will be as valuable as the roentgen treatment alone. KIRSTEN UTHEIM.

**Haret et Grunkraut: Position of Pelvis for Radiation.** La Presse Médicale, 1920, No. 89, p. 877.

The author strongly recommends two positions: (1) that known as Trendelenburg, (2) that of the knee chest position. The former is more applicable for radiation directed more anteriorly, while the latter is better for posterior radiation. The advantage of both of these positions is that if the intestines are movable, they slide away from the structures to be treated. The mobility of the intestines should be determined before radiation. The author thinks the best angulation of the body is between 30 and 40 degrees. F. L. ADAIR.

**Rohdenburg and Prime: The Effect of Combined Radiation and Heat on Neoplasms.** Archives of Surgery, 1921, ii, 116.

It was found that by subjecting mouse and rat sarcomata and carcinomata to low degrees of heat (41° to 46°), certain changes took place in these growths, ending in necrosis, if the treatments were prolonged or repeated. The heat was applied by means of electricity (diathermy). It was further found that tumors so treated were much more vulnerable to moderate doses of x-ray.

Hoping thereby to extend the field of usefulness of radiotherapy, the authors have begun to apply this combined treatment to human beings. R. E. WOBUS.

**Rénon and Degrais: Pregnancy in the Course of a Myelogenous Leukemia Treated with Radium.** Journal de Radiologie et d'Electrologie, 1921, v, 139.

A woman suffering from myelogenous leukemia improved under radium treatment to such an extent that she conceived and carried to full term. The child, now five and one-half years of age, is well

developed and shows a normal blood picture, though at the time of birth the mother had suffered a severe relapse of her leukemia. She died nine months after delivery, having received sixteen radium treatments within three years and one month. A leukemic woman may give birth to a healthy child because the placenta which permits the passage of soluble substances, is an impassable barrier to formed elements of the relatively large size of white blood corpuscles.

GEORGE GELLHORN.

# Items

## Sheppard Towner Bill

The American Gynecological Society, at its Forty-sixth Annual Meeting held June second to fourth, 1921, took the following action regarding the Bill for the Protection of Mothers and Infants commonly known as the Sheppard-Towner Bill.

This action of the Society was taken, almost unanimously, after careful consideration of a report of its Committee on Maternal Welfare acting jointly with a similar Committee of the American Child Hygiene Association.

"This Society wishes definitely to state its position for the information of the medical profession and others who are interested in this legislative program.

"1. The committee is in thorough accord with the ends which this bill seeks to attain, namely, the protection of the health of mothers and infants.

"2. We endorse the coördination of all health activities under one head. We consider the protection of mothers and infants to be a *health measure* of paramount importance to the individual and the State.

"3. We oppose in principle the control of health measures by nonmedical individuals or boards.

"4. We believe in the local control of health activities as distinguished from federal. We approve and indorse the idea of propaganda and investigation emanating from the Federal Government.

"5. We do not indorse the Sheppard-Towner Bill in its present form because it does not conform to the above principles and because it embodies the questionable plan of subsidizing State Health Activities.

"6. We endorse the project of establishing a National Department of Health."

President: GEORGE GRAY WARD, JR.
Secretary: ARTHUR H. CURTIS
Committee: GEORGE W. KOSMAK
FRED J. TAUSSIG
FRED L. ADAIR (Chairman)

### Meeting of American Gynecological Society

At the Annual Meeting of the American Gynecological Society held at Swampscott, Mass., June 2nd, 3rd and 4th, 1921, the following new officers were elected for the ensuing year.

President, George Gray Ward, Jr., 48 East 52nd St., New York. First Vice President, Barton Cooke Hirst, Phila. Second Vice President, Walter P. Manton, Detroit. Secretary, Arthur H. Curtis, 104 South Michigan Ave., Chicago. Treasurer, Brooke M. Anspach, Phila. Other Members of the Council. Walter W. Chipman, Montreal. Dougal Bissell, New York. Fred L. Adair, Minneapolis.

The next meeting of the Society will be held in Washington, D. C., on May 1, 2, and 3, 1922, and the Headquarters of the Society will be at the Hotel Washington of that city.

## Book Notices

Acknowledgment is made of the receipt of the following books, selected reviews of which will appear in early numbers.

UEBER DIE ENTWICKLUNG UND DEN AUSBAU DER SUPRASYMPHYSÄRAN SCHNITTENTBINDUNG. By Emil Vogt, Berlin, 1921, Verlag von S. Karger.

DIE THERAPIE DER PLACENTA PRAEVIA. By Dr. F. Hitschmann, Berlin, 1921, Verlag von S. Karger.